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# BIBLIOGRAPHY

OF

# X-RAY LITERATURE AND RESEARCH.—1896-97.

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# BIBLIOGRAPHY

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# -RAY LITERATURE AND RESEARCH.

(1896—1897.)

BEING A READY REFERENCE INDEX TO THE LITERATURE
ON THE SUBJECT OF RÖNTGEN OR X-RAYS.

EDITED BY

**CHARLES E. S. PHILLIPS,**

With an HISTORICAL RETROSPECT

AND A CHAPTER,

"**PRACTICAL HINTS,**"

BY THE EDITOR.

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# PREFACE.

IT is hoped that there will be found in this compilation something more than a mere glorified book catalogue or miscellaneous reference list. Rather, indeed, is it a humble attempt to place in the hands of the experimentalist a useful key to the literature of X-Rays, and to weave into the dry matter of fact a thread of interest.

It may not appear necessary perhaps, to supplement so definite a title as "Bibliography" with any further explanatory remarks here; nor would I add more now were it not that I wish to draw attention to one or two matters which have presented themselves during the progress of the work.

To begin with, besides the reference numbers and cross-references themselves—all useful enough, it is hoped—there are cases where it was thought advisable to couple together the references relating to similar matters. Then again, brief abstracts have been given as a further guide to the nature of the articles to which they relate, and all have been condensed as much as was reasonably possible. Further than this, an occasional subject-heading has been slightly altered where that was thought to be an advantage.

The references relate to the principle articles which have appeared on the subject of X-rays up to March, 1897, but it is intended to re-arrange the Book from time to time and bring it quite up to date.

I cannot hope to have done more than reduce errors to a minimum. If any still remain, I shall indeed be obliged to readers who will be good enough to bring them to my notice.

May I further add that it would be considered a great privilege if authors of important Papers or Books upon Röntgen Rays and allied subjects, will, from time to time, call my attention to their work in order that the Bibliography may always be made as complete as possible. The study of electric discharges has been carried on now over a considerable period. Very many physicists have added their quota of ideas or experimental results to the already existing heaps of unsorted knowledge, until it has become not only useful, but as most think, absolutely necessary for further progress that some real attempt be made to separate the "wheat from the chaff," to sort out the mere paper of it all, and condense the ideas and results.

In conclusion, I desire to acknowledge my indebtedness to those who have kindly assisted, either by useful suggestions or in checking the cross-references; while to my assistant, Mr. Coton, and to Mr. George Tucker, the publisher, my especial thanks are due for the interest they have shown and for the help they have given.

CHARLES E. S. PHILLIPS.

# RETROSPECT.

## HISTORICAL.

HISTORY has toiled hard to record the small beginnings out of which there has sprung one of the most important branches of physical science. Notwithstanding this, however, a vagueness still clings to the early accounts of a certain so-called "electric egg," and of the peculiar properties observed concerning it; all doubtless associated then by many with witchcraft or devil-doings, and now by no means to be laid aside as useless, but rather utilised as a starting point.

To Otto von Guericke we owe the very first vacuum **1650** experiment. His work laid the seed—very potential as GUERICKE we now know—which has given such an abundant harvest. He invented the first air-pump and ingeniously applied it to his investigations in Natural Science, so that when the eminently respectable Abbé Nollet who, for respectability's NOLLET. sake *called himself* the Abbé, took up with Science (let us suppose, also out of sheer noble-mindedness) and decided to turn his attention to this subject, Guericke's pump, **1740** together with the facts accumulated by Haukesbee, Gray, Dufay, Gilbert, Hooke and a few others, must have been of great importance. To the Abbé Nollet electricity was a highly inflammable fluid which was capable of being set into flame by the least shock—his books* upon the subject are, in view of modern discovery, exceedingly interesting.

He employed glass egg-shaped globes in his experiments, exhausted of air more or less and connected to the electric machine by means of an iron chain. He certainly observed some remarkable effects when the machine was set in motion. In one of his little books‡ there is an illustration depicting the operation of electrically exciting an exhausted set of glass vessels, and we see pictured there some of the effects so well known to physicists of the present day.

No particular progress is reported however, till about a hundred years later, when the electric egg effects were repeated by more competent experimenters. One of the few landmarks of that time is a statement made by
1834 Sir W. Snow Harris. He pointed out that the length of the spark which an electric machine will give in air varies in the simple inverse ratio of the gas pressure. This was very suggestive no doubt, but, as it seems to us now, somewhat a bold statement to have made in the year 1834, when little or no accurate work had been done in the matter.

Nor do we find that any results of much importance in
FARADAY. this direction had been obtained till Faraday, whose name
1838 is of all names, so intimately associated with the whole subject of British research and experiment in the important field of electrical and allied phenomena, and who four years later, while busy with his "Experimental Researches," had, memorably for us, turned his attention to the investigation of electric glow discharges.

But by him the "electric egg" had been modified considerably drawn out into a tube in fact, closed at both ends, and more thoroughly exhausted of the air within it.

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* "Recherches sur les causes particulières des Phénomènes Electrique;" "Essai sur l'Electricité des corps."

‡ "Recherches sur les causes particulières des Phénomènes Electrique." p. 174.

Heinrich Geissler, too, had by this time come forward with improved methods of making such glass tubes, and showed as well how to seal little platinum wires into their closed ends, besides inventing a special air-pump for exhausting them. The beautiful glow of the Geissler tubes lent a fresh attraction to the study. Faraday examined this glow minutely, and speaks of the peculiar effects produced in it by varying the rarefied gas within the tube. GEISSLER. **1838**

The main result to remember from it all is, however, that he observed an unilluminated space surrounding the negatively-charged electrode in almost every case. The extent of this dark area was found to depend upon certain easily-producible conditions—degree of rarefaction, potential difference between the electrodes, spark length of the coil, and so on.

But the work of experimenting was mainly organised with the indirect object of clearing up a very knotty point. It was doubtful whether the rays emanating from the electrodes were to be considered as ether wave disturbances or as the result of rapidly-moving particles of electrified matter.

That was the point to be settled. Even to-day, in the light of modern research and strings of likely hypotheses, the question is still open: rather widening perhaps than otherwise.

The early notions of electrical conductance, inductance and discharge effects, had been built upon some foundation of charged particles. The "Experimental Researches" are saturated with such ideas; they all point, or seem to point, to the effects observed as being largely due to the mutual action of electrically-charged material particles. For instance, the change in shape of a water drop suspended from a charged rod is a phenomenon evidently due to the rush of air (of electrified air that is) along the rod and off at the end, skimming past the drop and flattening its sides in consequence. But while such concrete phenomena as this could be explained on the old basis, it did not follow that the electrical condition itself was necessarily only associated with purely material affinities. The continental physicists, on the other hand, were developing what seems in one sense to be a broader hypothesis.

That a current of electricity flowing along a conductor can induce an electrical condition in a neighbouring conductor running parallel with it presented a great difficulty.
**1840** In a letter to Dr. Hare, Faraday wrote: "I have said I believe *ordinary induction* in all cases to be an action of contiguous particles, and in the former, assuming a very hypothetical case, that of a vacuum, I have said nothing in my theory forbids that a charged particle in the centre of a vacuum should act on the particle next to it, though that should be an inch off. . . . ." Clerk Maxwell was about nine years old when Faraday was writing to Dr Hare, but he was destined before long to say a good deal about this "ordinary induction," and for that matter many other questions as well.

AXWELL. According to Maxwell, a few years later, an electromagnetic disturbance could be traced to the propagation of a wave of more or less definite form, and transmitted at a definite rate through space. It seems that he had gone to the very root of the question by developing the electromagnetic theory of light,* although, so far, there had been no very conclusive experimental verification of his views. That was to come later.

In the meantime a number of physicists were discussing electrical discharge experiments, viewing the matter from many points, improving apparatus and in fact accumulating a mass of startling results. Everything seemed to still point to the observed effects being largely due to atomic activity. A literature of the subject was beginning to spring up, and the researches themselves were considered likely to be of great importance.

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* *Phil. Trans.*, Vol. 155, 1864.

The suggestion made by Sir W. Snow Harris had by no means been forgotten or even temporarily set aside.

MASSON.

M. Masson had already done something to confirm the relation between gas pressure and spark length when Sir W. Thomson* (now Lord Kelvin) introduced the absolute electrometer, and increased the field of inquiry.

SIR W. THOMSON.

**1860**

The merest glance at the scientific literature of this period serves to show that much real progress had been made; the study of electrical discharges had veritably leapt into importance.

Observations by Grove, Quet, Despretz, Plücker and Rhumkorff of the stratified appearance in certain cases of discharge glow had helped to lay the way clearer for later investigators, while it is to be noticed also that there is generally a chain of ideas, a definite purpose in fact, visible amongst their results. In one of two Papers upon this subject communicated to the Royal Society of London, Mr. Gassiot points out that this stratified condition does not necessarily require that an induction coil be used to excite the glow.

GASSIOT.

This work of Gassiot's was of a very original character. To set up 3,520 water cells, probably the largest battery of its kind ever made, and to properly insulate them, was no small achievement; but this he did, and proved too, by its means, that a vacuum tube placed in circuit with the cells glowed distinctly and with a stratified appearance. This was the beginning of a research in an entirely new direction, namely—the replacing of the Rhumkorff coil by cells. Gassiot persisted in his inquiry, and constructed other large batteries of various descriptions. Four hundred Grove cells were successfully tried, and also, beyond this, by means of 512 Daniel cells (which also gave the glow effects in an exhausted tube), he showed that there was good

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* *Proc. Roy. Soc.* Lond., Vol. X., p. 326, 1860.

1860 reason to consider the discharge intermittent, and that the stratified appearance of the glow may be generally the result of an intermittent force acting upon highly attenuated and resisting media. The details of his researches can, from sheer necessity, find no place here. His experiments were so numerous and extensive that they can now only be merely hinted at, but mentioned nevertheless with a full appreciation of their importance in the history of this matter. The general result of it all was nothing very important beyond the fact that notions of the discharge phenomena were expanded by his work, and the advisability of studying the striated discharge brought more prominently forward.

As affairs stood, however, there was no very wide result to be expected until more attention had been given to manipulative details. The apparatus required improving.

1865 SPRENGEL Just at this time (in the nick of time, one might say) Hermann Sprengel invented his mercury air pump. It was as simple as it was effective, and now is doubtless so well known as to require no further comment. But the great use of it consisted in its power of producing

1869 HITTORF very high rarefactions, and with rapidity. The name of Hittorf is closely associated with the early experiments under these improved conditions. The experimental results obtained on all sides were generally interpreted differently

GOLDSTEIN 1876 abroad, and M. Goldstein particularly expressed very strongly his view of the question.

With us, however, Gassiot's results looked more and more suggestive. The work on striæ and the observations of those already named were confirmed and enlarged

1877 by Warren de la Rue, Hugo Müller, and W. Spottiswoode.

WARREN DE LA RUE HUGO MÜLLER. SPOTTISWOODE. A mass of information was being got together—useful, almost vital on certain questions, but altogether becoming rather lacking in any particular order.

At the same time the outcome of the work of these investigators was in many ways very definite and important. To begin with, they greatly improved the methods of working, elaborated the Sprengel pump, and made useful additions in other apparatus as well. Then the interrupters of their induction coils were experimented with; the vibrating spring make-and-break was replaced for a time by a conducting rod attached to a rocking lever, which, dipping into a cup of mercury-platinum amalgam, produced there no doubt troublesome sparks whenever the rod was lifted out to break the circuit. A rotating mirror was employed for examining striæ, and finally the results were summed up in a series of beautiful drawings of the effects observed.

Numbers of curious relations were noticed; thus the experimenters point out that "all strata have their origin at the positive pole," that "the greatest heat is in the neighbourhood of the strata," while "at the same pressure and with the same current the diameter of the tube affects the character and closeness of the stratifications."

**1879** CROOKES.

The British Association met in 1879 at Sheffield, and there, on August 22, Mr. (now Sir William) Crookes made known to the world the results of his work upon this subject. The dark space noticed by Faraday had been to him a fruitful field for research, and his numerous ingenious experiments had led to many curious conclusions—results in fact which seemed to broaden the whole study and likely to be of great interest to science generally. During the work certain ideas had been accumulated as to a probable new condition of matter—a fourth state—radiant matter!

There was something strikingly new and original about all this that attracted universal scientific attention, and naturally enough considerable antagonism as well. M. Goldstein had already opposed such notions; and here let it be noticed how peculiarly contradictory appear the conclusions of the two schools. Both have something in common, both seem right on many points, but yet they differ fundamentally. No one has done more to uphold the corpuscular theory than Sir William Crookes, although the atomic particles of matter flying with their electric charge across the rarefied space of a vacuum vessel are to him imbued with properties other than those strictly material.

Of all his experiments there is one that stands out strongly and with direct bearing upon this question of the material nature of the rays. By properly adjusting the vacuum, and by curving the negative electrode into a concave mirror, a pivoted vane placed in the exhausted vessel, so that it looked at the concave side of that electrode, whirled round vigorously when the vessel was electrically excited. Undoubtedly, and by independent experiments, it had been shown that matter behaves strangely when placed in a highly attenuated medium, but a whole string of fresh questions arose directly that little vane swung round—questions altogether of a rather surprising nature.

Perhaps, too, some really practical application could be found for such a mechanical device: nothing of the sort could reasonably have been expected before.

But the cathode rays—particles perhaps—shot off from the charged negative electrode, were found by Crookes to possess some remarkable properties apart from any likelihood of a practical use for them.

The suggestiveness of the shadow cross-tube experiment, and others of that kind, may well be considered as laying the foundation for what was to follow.

**1883**
IEDE-
NN.
J.
IOMSON.

In spite of what seemed conclusive proof that the cathode rays are streams of charged particles, E. Wiedemann, in 1883, published a paper in which he adhered to the opinion that they are ether disturbances of very short-wave length. A little later Prof. J. J. Thomson suggested a theory of discharge based upon some experiments with gas electrolysis.

The molecules of matter are here assumed to absorb the energy of the electrostatic field, and to become decomposed into free ions. It will be remembered that Clerk Maxwell had some years before made certain all-important suggestions as to the propagation of an electro-magnetic wave, and by now an experimenter, combining the knowledge of theory with practical ability, had set himself the task of verifying experimentally what Maxwell had predicted.

This work was carried on at Bonn by Prof. Hertz, and only terminated through his untimely death in January, 1894. Such researches incidentally led him towards high vacua discharge experiments, and his work in that direction has been successfully carried on by his then assistant, Prof. Lenard. The possibility of causing cathode rays to pass through the walls of the vacuum tube has been proved by him. With a special form of tube, and with many precautions, cathode rays can be detected outside it and in the open air, but only for a very short distance from the thin metallic window through which they come. That discovery marked a revolution in the history of the subject. Many new problems started up. The external rays were caused to affect photographic plates, and also evidently had some properties in common with ultra-violet light. **1883 1894** HERTZ. LENARD.

It was thought that perhaps, by some peculiar means, a fresh stream of particles was set up outside the window of the tube. Could these effects be produced by particles actually shot out of the tube and *through* the window?

It has later been found that these cathode rays are by no means homogeneous. A pencil of them, in fact, is a very complex bundle of rays, some of which can be sorted out with a magnet, while others seem quite unaffected by a magnetic field.

Perrin in France, and Elster and Geitel in Germany, had given some attention to these later developments. PERRIN ELSTER & GEITEL.

The experiments of Hertz upon ultra-violet light and its curious property of discharging electrified bodies were brought forward and compared with Lenard's results—a busy work, of course, but still somewhat restricted. There could in fact be no very general interest taken in results involving such refinement of manipulation and with no very definite prospect before it of being of much practical *use*. In scientific circles the progress was being anxiously watched, but there was nothing so far of sufficient *general* interest to form even a three-line notice in a daily paper.

**1895** RÖNTGEN

Very briefly, then, that is how matters stood when Prof. Wilhelm Konrad Röntgen, of Würzburg, Bavaria, took up the subject. He was experimenting with various Lenard and Crookes tubes and an unexpected occurrence opened up a new vista. Some fluorescent material smeared on paper and lying near one of the excited tubes glowed visibly even when the tube was completely wrapped in a light-tight cover. The effect could not be due, therefore, to the presence of ultra-violet light; in fact was conclusively proved in the end to depend on some curious radiation from the tube itself.

It had already been shown that cathode rays, as known to Crookes and others, are affected by a magnet—can be deviated from their normal paths through the action of attraction or repulsion (as the case may be); so that *that* was one obvious test to be made with the rays—to magnetically affect them if possible.

But Prof. Röntgen found that these rays were *not* deflected by that means. Here was a new order of cathode ray—a new radiation! It is to be noticed that a considerable amount of work upon these new rays was done before the world was apprised of their existence. Their photographic action was demonstrated, and the different degree of opacity to them of many substances carefully ascertained—even some idea as to their probable origin was deduced—all culminating in the bone photographic triumphs.

The Physico-Medical Society at Würzburg then published Röntgen's communication on the subject, and, partly from its newness, its scientific value, and its obvious practical use, the discovery was received by all with surprise and enthusiasm. **1896**

Mr. A. A. Campbell-Swinton repeated in England the results already obtained on the Continent. Information on experimental details was hard to obtain and slow in coming, but in the end as good results were obtained in London as at Prof Röntgen's own laboratory. SWINTON.

The clear and well-defined radiographs so well known were not obtained with any certainty, however, until Mr. Jackson, of King's College, London, showed how to construct a more suitable tube for generating the rays. He had experimented some years ago with the appearance of certain fluorescent bodies under the influence of electric discharge, and had then used a special form of vacuum tube. Instead of allowing the cathode stream to impinge directly upon the glass wall of the tube, it was focussed upon a little flat plate of platinum or platinum-iridium placed at 45 degrees to the axis of the stream. By this means abundant X-rays are obtained, as it happens, and their source being practically a point, the sharpness of X-ray shadows obtained is greatly increased. The stream of cathode rays beating upon this platinum anti-cathode appears to become transformed there into the new rays, and diffusively reflected off as such. JACKSON.

A view of the matter, due to Sir G. Stokes, assumes that the little charged particles (if such they be) shot off from the cathode, and normal to its surface, produce in striking the anti-cathode a change in the electrical distribution of the electrical charge upon them, which sets up a disturbance in the surrounding ether and gives rise to the effects observed. STOKES.

It was only to go a step beyond Prof. Röntgen's original discovery for Salvioni to suggest the construction of a fluorescing screen for use with the rays. Platino-cyanide of potassium is perhaps rather better than platino-cyanide of barium for this purpose, but while both give good results they are also costly and require very careful handling. Mr. Edison's announcement that calcium tungstate, a much cheaper material, fluoresced strongly under the influence of X-rays, was looked upon with some interest. The calcium however is by no means so brilliant.

SALVIONI.

EDISON.

While many physicists were trying still further to improve the apparatus for generating X-rays, Lord Blythswood had obtained some curious photographs without any vacuum tube at all—merely by exposing covered sensitive plates to the discharge from a large Wimshurst machine.

BLYTHSWOOD.

Numbers of odd and disconnected results poured into the scientific journals, and bran-tub experimenting was at its height. Many irresponsible people were thrusting their hands in amongst the maze of phenomena suddenly opened up by Röntgen's work in the hope of seizing a prize. Behind this blind effort, however, there was steady and connected investigation being pursued.

LODGE.

Prof. O. Lodge had verified the non-deflectability of the rays by a magnet, and was further carefully experimenting in certain definite directions.

With the announcement of his discovery, Prof. Röntgen had hinted at the probability of the new rays being due to longitudinal waves set up in the ether by the electric discharge taking place in the tube.

JAUMANN.

Prof. Jaumann elaborated this idea mathematically, and the fact that the rays were not found to follow the ordinary law of optics rather favoured this view. But, looked at from another standpoint, there still remained a gleam of hope that after all it was a question of ultra-

ultra violet light rather than of any longitudinal wave phenomena. J. J. Thomson, Benoist, Hurmuzescu, Dufour and others had noticed that the new rays have the property (also possessed by ultra-violet light be it noted) of discharging an electrically-charged body. *That* did not fit in with longitudinal vibration notions, but instead pointed more to the rays being of the nature of ordinary light—especially, too, when the effect was found to be greater the smaller the angle of incidence.

J. J. THOMSON, &c.

Prof. O. Lodge had something to say about this, rather favouring the idea on the whole, and suggesting fresh experiments. A further advance in this direction was then made by Perrin, Lodge, Villari, Righi, Minchin and others, namely, the discovery that, after discharging the charged body, the X-rays produced a residual charge of either positive or negative electricity, depending upon circumstances.

VILLARI, RIGHI, MINCHIN.

Directly the prospects of the rays turning out to be short-wave-lengthed light were realised experiments upon their reflection, refraction, diffraction and polarisation were renewed with great activity. The result was unsatisfactorily negative, but yet, as would seem, fairly definite. No truly optical reflection could be found. Lord Blythswood had reflected the rays from speculum metal, and other traces of reflection from mercury surfaces must be mentioned, but, as Prof. S. P. Thompson pointed out, the reflection was so diffusive that it could hardly be called reflection at all in the strict sense. As to refraction, no one could find a trace of it; the same with diffraction. It was then, and is now, the general opinion that if, in fact, these phenomena exist at all for X-rays, they do so to an inappreciable extent. As to polarisation, the same thing may be said, while at the same time the results obtained by Galitzine and Karnojitsky must not be lost sight of. They got evidence of a trace of polarisation—very slight, but still a trace.

S. P. THOMPSON.

Considered generally then, all this work did not lead to much progress, except as serving to help in the understanding of what the rays were probably not.

ATELLI METZ.

One question that seemed worth settling was whether the cathode rays would have any photographic action before they struck the anti-cathode. Battelli and Metz placed sensitive films in the path of the rays and found a strong photographic action. Elster and Geitel continued their investigations on the photo-electric effect of ultra-violet light into the new region, and described very definite results with X-rays.

ORTER.

With regard to improvements in manipulation, Porter and Swinton are pre-eminent. But aside from all this busy work, Prof. Röntgen's discovery was turned to practical use from the first. Records of help in surgical cases, in removal of bullets, &c., attest to its importance practically.

Perhaps its wide popularity is due to this more than to any other cause. There has crept into this multifarious collection of facts a human interest which has become inextricably entangled with them. The sight of the actual bone-shadows of a living man, and with every detail about them crisp and clear, struck a wonder not altogether unassociated with a certain horror into the minds of many; the little crowds anxiously peering into scientific instrument makers' windows at the bare, fleshless portraits when the news of the discovery was but a few weeks old was a phase of the matter by no means to be thought lightly of—it told of the intenseness of the general interest. But there was still a big question open, and, as it seemed, easily to be answered. What action will the new rays have upon bacteria? It has been shown that ordinary light and, especially, that from the ultra-violet part of the solar spectrum, strongly checks their growth and development. What is evidently wanted, then, is a radiation with a very short-wave length, and in view of this the

X-rays were reasonably expected to have a sterilising action.

The importance of the question is self-evident, but still, in spite of this, not much has been done. Some of the results, too, are somewhat contradictory. Diphtheria can be cured by means of the rays, says the State University of Missouri, while W. M. Stine and MM. Lortet and Genoud report good results from treating cases of tuberculosis with the rays. The typhus bacillus seems, however, to care nothing whatever about X-rays, and so with bacteria in general the effect seems either vague or negative.

A look back at the 60 years of work on electric discharge reveals many notable things, amongst them the fact that of late all civilised nations have taken part in the research. The early work was almost entirely restricted to England, until its importance began to dawn upon all scientific bodies throughout the world.

Truly the " electric egg " has been well hatched!

C. E. S. P.

# PRACTICAL HINTS.

The following few notes are given here for what they are worth. They are expected to appeal more especially to physical students about to turn their attention to high vacua research.

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When a start is made to set up apparatus for this work, in blissful ignorance of the experimental struggle going on around, it soon becomes evident that the task is by no means an easy one. The mechanical air-pump, with its glitter and high finish, seems at first sight to surely form the basis of an installation of this kind. But as time goes on that device comes to be regarded as a useful adjunct to more effective apparatus rather than the most important laboratory appliance which it is the experimenter's privilege to possess. It is true, nevertheless, that very high rarefactions can be obtained by a good mechanical air-pump—a focus-tube may in fact be exhausted very satisfactorily with one of the "Geryk" pumps: but that is the end of the tether, and it is only by all manner of care that that result can be brought about. Here follow then a few hints upon such matters, and also some miscellaneous notes upon minor laboratory operations.

## THE AIR-PUMP.

The best apparatus for producing very high rarefactions is still the "Sprengel" air-pump or some modification of it. This pump was invented in 1865 and described in the Chemical Society's *Journal* of that year. Space cannot be spared to describe the pump here; it may be pointed out however, that it is the simplest, the most effective, and one of the cheapest of all air-pumps. A good account of this instrument can be found in "Electrical Engineering," by Slingo and Brooker.

In working with a Sprengel pump, attend to the following points:—

(1) Always use perfectly clean mercury. Mercury can be cleaned in the following ways:

- (*a*) Spraying it through dilute sulphuric acid; wash with water, and dry.
- (*b*) Well shaking with sulphuric acid; wash with water, and dry.
- (*c*) Keep saturated solutions of potassium ferri-cyanide and hypo-sulphite of soda. Mix equal parts of 25 per cent. solutions of these, and well shake the dirty mercury in the mixture. Renew the solutions and repeat, finally washing with water and drying the mercury in plaster-of-paris.

If the mercury contains much lead or tin it had better be re-distilled (this can be done at a cost of 1s. 6d. per lb. of mercury). To remove dust or dirt the mercury should be squeezed through soft chamois leather, or two or three layers of silk.

Notice that no matter how pure the mercury, the fall-tubes of the pump will become discoloured after a time.

(2) As the vacuum becomes high let the mercury run faster through the fall-tubes, but not too fast, as there is a risk of damaging the interior of the tubes and cracking them. In such cases they generally crack longitudinally.

(3) Be sure to have the lower mercury reservoir made removable, so that a beaker can replace it, and by this means the lower ends of the fall-tubes be dipped into acid or water for washing purposes. To wash the fall-tubes suck up strong sulphuric acid into them from the beaker, and when they are clean, wash them in the same way with water, ultimately drying by means of a current of dry air. The fall-tubes must be thoroughly dry before the mercury is again allowed to circulate.

Fig. 1 shows a convenient form of pump-head, with three fall-tubes. The funnel F may be useful for letting in a small quantity of acid into the fall-tubes, but if the lower reservoir is removable its function in this respect is not so important. It is very useful, however, for letting air into the apparatus after an exhaustion. Avoid putting fat on the stopper S: a little glycerine or pure sulphuric acid is best. The cup should then be about half filled with mercury. Such an arrangement is absolutely air-tight.

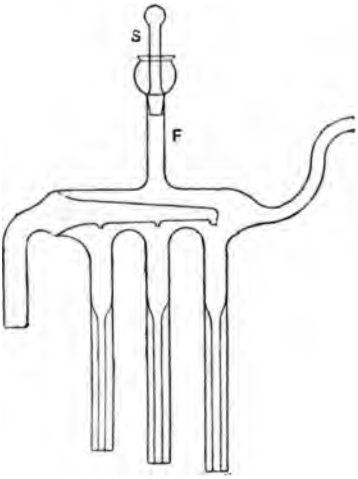

FIG. 1.—Sprengel Pump Head.

It is best to work with three or five fall-tubes—not more. Do not have the bore of these tubes smaller than $\frac{1}{16}$in. It is no objection to have a join in the fall-tubes—it does not mar the working of the pump—so that if one breaks it can be repaired without interfering with the efficiency of the apparatus. It is generally a great advantage to use a mechanical and rapidly-acting air-pump in connection with the Sprengel. This saves time. When the vacuum produced by the mechanical pump is at its highest the glass leading tube should be melted and sealed up with a blow-pipe, and the exhaustion completed by the Sprengel.

## DRYING TUBES

Must always be employed in conjunction with the pumps. If sulphuric acid is used for drying purposes, the tube shown in Fig. 2 will be found convenient.

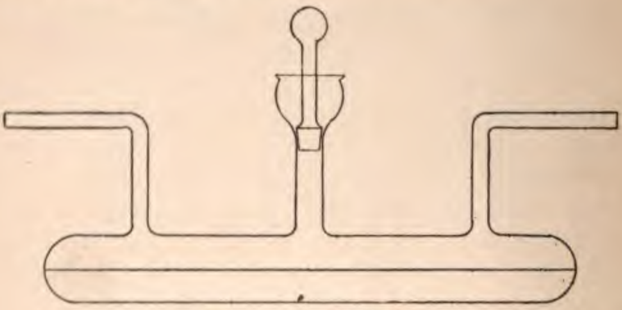

Fig. 2.—Drying Tube.

Sulphuric acid can be poured in or sucked up through the funnel when requiring renewal, and when in use the stopper, as before, can be mercury-sealed. Sometimes phosphoric acid is used to dry over instead, and in that case the tube need not have a funnel blown on. It should be filled with the $P_2O_5$ before the end is closed in the flame and re-charged (after properly washing out with warm water and then drying) by bursting out the same end while it is softening in a blow-pipe flame. These tubes are quite easy to set up, and only involve the ability to make a non-cracking glass T-joint. They should be about 6in. long and of $\frac{3}{8}$in. glass tubing.

## AIR-TIGHT CEMENT.

Take eight parts by weight of beeswax and three of resin; melt these together in a large test-tube and filter while hot. This cement can be used for sealing up cracks in glass apparatus, for sealing caps or lids into vacuum vessels, for mending up cracked fall-tubes of the Sprengel, and so on. It will withstand a very high pressure for some hours, but is not quite permanently air-tight. Probably this lowering of the vacuum after a time where a cement is used may be due to some extent to a vapour slowly given off by the cement itself. Shellac is an excellent cement for our purpose, also ordinary sealing-wax, and sometimes even starch solution.

## THE CEMENTING FLAME.

Draw one end of a piece of glass tubing out to a fine point and attach the other end by means of rubber tubing to the gas supply, snap off the extremity of the fine point and light the little jet of gas. This flame is invaluable for adjusting and smoothing a cemented joint. By its means the joint can be as it were painted, and the cement made to run into every tiny opening, at the same time causing any air bubbles to disperse. The little flame should be about $\frac{1}{4}$in. long.

## AIR-TIGHT JOINTS.

If possible, make all joints glass-sealed. Instead of joining two portions of a glass leading tube together with rubber pressure tubing or a larger tube overlapping the two ends and filled in with sealing-wax, weld the two glass ends together by means of a small portable mouth blowpipe. Use considerable heat for this operation, and blow the joint, as prescribed in books on glass-working. By this means all possibility of leakage at the joint is removed, and this is always an important consideration.

There is, however, a very perfect form of joint in which oil or mercury is used as the sealing agent. Such a joint is shown in Fig. 3. G G are the tubes to be joined,

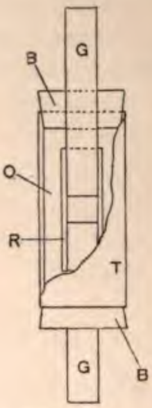

FIG. 3.—Oil or Mercury Joint.

and B B are rubber stoppers, which must just fit tightly enough to prevent mercury or oil escaping from the tube T. The tubes G G are brought together and held in position by the rubber pressure tube R. The space O is nearly filled with oil or mercury. Such a joint, although troublesome to break and re-make, is very reliable when properly set up.

Do not use rubber pressure tubing to lead from one part of the apparatus to another in the case of high rarefactions; glass is always preferable.

## STOP-COCKS.

The stop-cocks usually sold by instrument makers are quite useless for high vacua work. They are pretty to look at, and that is about all that can be said of them from our point of view. It becomes very expensive to have an air-tight glass tap made, as the grinding necessary is of a rather special kind. Even then the chances are the tap will give out just when it is least wanted to. Sir W. Crookes used platinum taps on his original Sprengel pump. Taking everything into consideration, the pinch cock seems the best for the pump, and welded joints for the rest of the apparatus.

## EXPERIMENTAL TUBES.

The form of tube shown in Fig. 4 has been found suitable for various electrode experiments. The stoppers S S were ground into the tube, as shown, and could easily be removed, either for cleaning the tube or readjusting the electrodes. When the stoppers were replaced for an experiment a thin film of the wax-resin cement was painted over them and adjusted with the cementing flame.

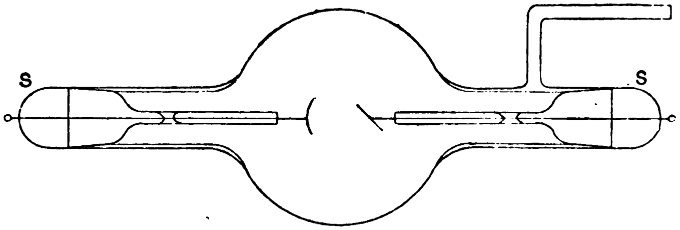

FIG. 4.—Experimental Focus Tube.

For many cathode-ray experiments however, the following simple and inexpensive device (shown in Fig. 5) was found to have some advantages.

The bottle G was bought at a chemist's. A rubber ring of round section R was then obtained from a plumber, and slipped over the lip of the bottle as shown. T and T′ are glass tubes fitting tightly into the rubber bung C, which itself fitted closely into the neck of the bottle. Notice that the leading wires could be made of copper, except just where they were sealed through the glass. The tube T was closed at the bottom, and T′ sealed to the pump. A cardboard cylinder B was then slipped over the rubber ring R and cemented there with wax. When all had been got into position, mercury was poured into this cardboard tube up to the dotted line M, and covering the stopper C. By this means all the joints were mercury-sealed. Such an arrangement was found to be capable of withstanding very high exhaustions. A simple form of experimental focus tube is shown in Fig. 6. It can be made quickly, and does not involve any great knowledge or practice in glass-working.

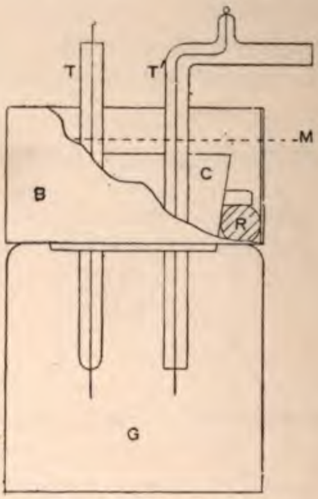

FIG. 5.—Experimental Tube.

It should be pointed out here perhaps, that all these tubes require to be left on the pump and will not be of much permanent use if sealed off from it. They are essentially for experimental work.

The tubes T and T′ slide freely in the sleeves S S′. These sleeves are welded into the thicker tube after it has been drawn down in the flame. The bulge B is blown out in order to thin the glass there. For details of such operations see any good manual on glass blowing. The electrodes themselves may be of whatever metal is desired, but as regards the long leading wires, they should be of copper and cemented into the protecting tubes T and T′.

These tubes are themselves next to be cemented into the sleeves S S′, and the apparatus is ready for work. Such a tube is usually set up with some definite purpose, to test some combination of electrodes or examine an expected new result. The cemented joints, all properly adjusted by means of the cementing flame, are shown by the section lines. It is possible to adjust the electrodes—bring them nearer together for instance—in such a case without increasing the gas pressure within. This requires careful manipulation of the little flame when softening the cement at each joint, but it can be done. In any case, the probability is an adjustment of electrodes will not involve an important rise of pressure, and the pump will soon withdraw what little air may have leaked in while the cement was temporarily hot and soft.

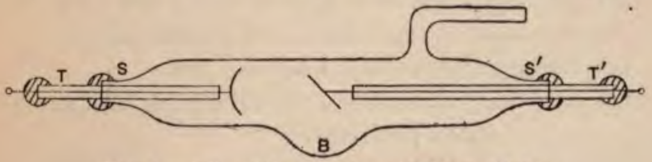

FIG. 6.—Adjustable Experimental Focus Tube.

It is difficult to exhaust any vessel in which much wax or rubber is exposed, and it is therefore generally desirable to keep any cemented joints as closely-fitting as possible, so that merely a film of cement will be exposed in the interior of the tube. All glass leading tubes between the vessel being exhausted and the pump should be small, so as to expose less surface of glass, and to save time in exhausting.

## VARYING THE VACUUM IN A SEALED OFF-TUBE.

This may be accomplished in four ways :—

(1) By heating the tube with a spirit lamp flame, and thus dislodging matter from the inside of the glass ;
(2) By electrically heating some fairly absorbent body placed in the tube before exhausting;
(3) Using various spark lengths ; and
(4) Attaching electrified foil to the outside of the tube in various positions.

The flame method is the most common, but No. 2 is probably more under control.

In the case of focus tubes for Röntgen-ray work, and in cases where the vacuum is very high, this vacuum can apparently be altered by varying the spark length used with the tube.

A focus tube exhausted up to the blue-haze effect and with the appearance of the merest green tinge about it, but with no emission of Röntgen rays, was sealed up and left for three months. After that time the tube fluoresced brilliantly green when excited, and gave strong Röntgen rays. Continual working for some minutes again lowered the vacuum, which had again become higher after an hour's rest. The vacuum can alter therefore of itself, due probably to occlusion of the rarefied gas by the metallic electrodes. A focus tube should be made with plenty of space behind the cathode, for that is the best place to heat if it is desired to increase the pressure within.

## SEALING A PLATINUM STAR OR CROSS INTO GLASS TUBES.

The following method has been found successful: Cut off a suitable length of glass tubing, weld in the cathode electrode, and blow on a side tube, as shown in Fig. 7. See that the end A is fairly true, lay the platinum cross or star upon that end, and while keeping the glass hot, fasten it there with a little bead of soft glass (lead glass), melted on to each radial wire. Be careful to keep the end A still hot in the flame, and bring slowly up to it the end B of another piece from the same length of tubing, press the ends together as they soften in the flame—make, in fact, an ordinary straight joint there. Such a joint properly made should not crack, but the secret of success in this, as in most glass work, lies not so much in the over-rated annealing process as in a proper and even distribution of the glass about the joint. Metallic spirals, discs, &c., can be sealed into a glass tube in this manner, and in experiments where electrical currents are to be passed along the electrodes, such a device may be helpful.

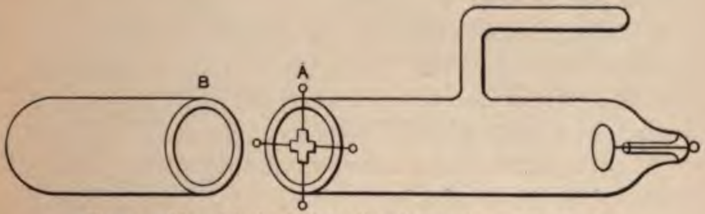

FIG. 7.—New Method of Sealing-in Platinum Electrodes.

The tubes illustrated in *The Electrician*, Feb. 12, 1897, p. 498, were made in this way.

## SPECIAL METHOD FOR SEALING ALUMINIUM WINDOWS TO LENARD TUBES.

This has always been a difficulty. Cements answer up to a certain point, but they are not reliable. The following method is suggested, and it will be seen that no cement of any sort is used.

A considerable thickness of copper was electrically deposited upon the open end of a glass tube. In order to get the metal to adhere to the glass a layer of gold leaf was burnt on to the tube by means of the blow-pipe flame. There was no difficulty in this. The gilded end of the tube was then, after careful cleaning,* suitably connected to the plating circuit and copper deposited upon it in a boiling solution of copper sulphate. After six hours the tube was removed and dried, and a metal cap *soldered* on to its coppered extremity. The copper having been deposited at a high temperature, contracted upon being removed from the hot solution, and so gripped on to the gold-coated glass with great force. The tube was found to be quite air-tight. Any form of window may be either soldered or *screwed* on to the metal-coated tube.

C. E. S. P.

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* *See* "Electro-Plating" by T. W. Urquhart, pp. 21-34.

# BOOKS AND PAMPHLETS ON X-RAYS.

The following List gives all the Books and Pamphlets published to date on X-Ray Research, &c. These works can be supplied (*post free* at the prices indicated) by "THE ELECTRICIAN" PRINTING AND PUBLISHING COMPANY, 1, 2 and 3, Salisbury Court, Fleet Street, London, England. For postage out of the United Kingdom add 5 per cent. :—

**THE NEW PHOTOGRAPHY.** By A. B. CHATWOOD. 1896. Price 4s.

Quite half this book is devoted to colour photography, ghost photography, &c., &c., and the portion of it relating to X-rays is very

**LIGHT, VISIBLE AND INVISIBLE.** By Prof. SILVANUS P. THOMPSON, D.Sc., F.R.S., M.R.I. Price 6s. nett. (Published 26th Oct., 1897.)

This is a reprint of a series of Lectures delivered at Christmas, 1896, by the author at the Royal Institution of Great Britain. The Lectures have been amplified, and the book contains a large number of excellent illustrations.

One of the most important books published so far upon this subject. It deals very carefully with the study of electric discharges in vacuo, and brings together the numerous theories advanced at different times to account for these phenomena. It is well illustrated and contains many excellent radiographs. A useful "Table des Matières" is given at the end of the volume.

**THE A B C OF THE X-RAYS.** By W. H. MEADOWCROFT. 1897. Price 4s.

This book is of a very elementary character, both from the scientific and literary points of view, and we cannot recommend it.

**THE INDUCTION COIL IN PRACTICAL WORK (including Röntgen X-Rays).** By LEWIS WRIGHT. 1897. Price 4s. 6d.

A volume of real practical use, and probably the most complete English work published so far on this subject. It has the great disadvantage, however, of being without an index.

**PRACTICAL RADIOGRAPHY.** By A. W. Isenthal and H. Snowden Ward, F.R.P.S. Price 2s. 6d.

A well and profusely illustrated book, containing much information of practical use. There is a chapter on "How to Make an Accumulator," and also directions for the construction of induction coils, besides notes on photography and fluorescing screen work. This is a new and enlarged edition.

**THE ARCHIVES OF THE RÖNTGEN RAY.** Edited by W. S. Hedley, M.D., and Sydney Rowland, M.A. Price 4s.

A quarterly publication in which the proceedings of the Röntgen Society of London are reported, besides containing many original articles and illustrations. The illustrations are large photographic reproductions, and greatly add to the value of the journal.

**THE NEW LIGHT.** (Special number of the *Photogram.*) Price 3d.

A pamphlet of 24 pages. This is one of the earliest publications upon the subject of Röntgen rays, and contains many original articles besides a few important translations. There is to be found here a translation of Herr. G. Jaumann's Paper on "Longitudinal Light" (from *The Electrician* for January 24, 1896), as well as Prof. Röntgen's contribution to the Würsberg Physico-Medical Society on "A New Kind of Rays." There are numerous illustrations.

**THE RÖNTGEN RAYS IN MEDICAL WORK.** By David Walsh, M.D. (Edin.), with an Introductory Section upon Electrical Apparatus and Methods by J. E. Greenhill. 1897. Price 7s. 6d.

This is a thoroughly useful and practical volume. It treats in a terse manner with all the medical applications of the new rays, and is very fully and photographically illustrated. The book has a great deal of order about it and its index is carefully compiled. It is to be highly recommended to all studying the subject, whether from a medical or the purely physical point of view.

**LA TECHNIQUE DES RAYONS X.** By A. Hébert. 1897. Price 4s. 6d.

The folding illustrations in this book are a distinct feature. The elements of the subject are briefly treated and the greater part of the book devoted to work since 1896. It is a valuable contribution to the literature of the subject.

**LA RADIOGRAPHIE APPLIQUÉE A L'ÉTUDE DES ARTHROPATHIES DÉFORMANTES.** By Dr. F. Barjon. 1897. Price 6s. 6d.

A book of some 260 pages, treating of rheumatic conditions and their effect on bone formation as shown by the rays. It is, however, essentially medical, and in fact in the latter part of the work only deals with the application of X-rays to this particular purpose.

**A MANUAL OF MEDICAL ELECTRICITY, WITH CHAPTERS ON THE RÖNTGEN RAYS.** By Dawson Turner, B.A., M.D., &c. Price 7s. 6d.

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COLUMN III. the periods or intervals of publication.

COLUMN IV. the price of single copies with postage, and annual subscription post free, where this information is obtainable.

*A useful list of the Published Books dealing with X-Ray Work will be found on pp.* xxxiii. *and* xxxiv.

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Orders for all these Publications can be received by 'The Electrician' Printing and Publishing Company, 1, 2 and 3, Salisbury Court, Fleet Street, London, England, at the prices quoted which must in all cases accompany the order, and every effort will be made to assist those requiring publications which devote space to the discussion of X-Ray and cognate subjects.

| Abbreviation. | Full Title. | Published. | Price. Single Copy. | Price. Annual Sub. U. K. | Price. Annual Sub. P. U. |
|---|---|---|---|---|---|
| | | | s. d. | £ s. d. | £ s. d. |
| *Acad. Imp. des Sci.* | *Memoires de l'Academie Imperiale des Sciences de St. Petersbourg* (St. Petersburg) | — | 13 0 | — | — |
| *Am. Ann. of Phot.* | *American Annual of Photography* (New York) | Yearly | 4 6 | — | — |
| *Am. Elec.* | *American Electrician* (New York and Chicago) | Monthly | 0 6 | 0 9 0 | 0 9 0 |
| *Am. Jnl. of Science* | *American Journal of Science and Arts* (New Haven, Conn.) | Monthly | — | — | |
| *Ann. Chim. et Phys.* | *Annales de Chimie et de Physique* (Paris) | Monthly | 2 6 | 1 8 6 | 1 8 6 |
| *Acad. Med. Chirurg* | *Atti dell'Accademia Medico-Chirurgies de Perugia* (Italy) | — | — | — | — |
| *de Lincei* | *Atti della Reale Accademia dei Lincei* (Italy) | Semi-monthly | — | — | — |
| *Ber.* | *Sitzungsberichte der Koniglich-Preussischen Akademie der Wissenschaften zu Berlin* | — | — | — | — |
| *Jnl. of Phot.* | *British Journal of Photography* (London) | Weekly | 0 2 | — | — |
| *Brit. Jnl. of Phot. Al.* | *British Journal of Photography Almanac* (London) | Annual | 1 0 | — | — |
| *Brit. Med. Jnl.* | *British Medical Journal* (London) | Weekly | 0 6 | — | — |
| *C. R.* | *Comptes Rendus des Seances de l'Académie des Science* (Paris) | Weekly | 0 7 | 1 6 6 | 1 6 6 |
| *Chem. Zeit.* | *Chemiker Zeitung* (Germany) | Semi-monthly | — | — | — |

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|---|---|---|---|---|---|
| *Jenaish Zeit. f. Nat.* | *Jenaische Zeitschrift für Naturwissenschaft* (Jena) | — | — | — | — |
| *Jour. of Cam. Club.* | *Journal* of the Camera Club (London) | — | 0 6 | — | — |
| *Jour. f. Gasbeleuchtung* | *Journal fur Gasbeleuchtung und Wasserversorgung* (Germany) | — | — | — | — |
| *Jour. de Phys.* | *Journal de Physique* (Paris) | Monthly | 1 0 | 0 12 6 | 0 12 6 |
| *La Nat.* | *La Nature* (Paris) | Weekly | 0 6 | — | — |
| *l'Eclair. Elec.* | *l'Eclairage Electrique* (Paris) | Weekly | 0 10 | 2 8 0 | 2 8 0 |
| *l'Elec.* | *l'Electricien* (Paris) | Weekly | 0 6 | 1 1 0 | 1 1 0 |
| *l'Ind. Elec.* | *l'Industrie Electrique* (Paris) | Semi-monthly | 0 8 | 1 1 0 | 1 1 0 |
| *Mem. Acc. Linc.* | *Memorie della Reale Accademia dei Lincei* (Italy) | — | — | — | — |
| *Mem. R. Istit. di. Sci.* | *Memorie del Regio Istituto Veneto di Scienze* | — | — | — | — |
| *Münch. Med. Woch.* | *Münchener Medizinische Wochenschrift* (Munich) | — | — | — | — |
| *Nature* | *Nature* (London) | Weekly | 0 6 | — | — |
| *N. Cim.* | *Nuovo Cimento* (Pisa, Italy) | Monthly | 1 3 | 0 15 0 | 0 15 0 |
| *Phil. Mag.* | *Philosophical Magazine* (London) | Monthly | 2 6 | 1 10 0 | *1 12 6 |
| *Phil. Mag. Abs.* | *Philosophical Magazine Abstracts* (London) | — | — | — | — |
| *Phil. Trans.* | *Philosophical Transactions* of the Royal Society of London | Irregularly | Varies | — | — |
| *Phot. Jnl.* | *Photographic Journal* (London) | Monthly | 0 6 | — | — |
| *Photography* | *Photography* (London) | Weekly | 0 1 | 0 6 6 | 0 8 8 |
| *Phys. Rev.* | *Physical Review* (Ithaca, U.S.A.) | 5 parts in ½ year | 2 6 | 1 2 6 | 1 2 6 |
| *Popular Science* | *Appleton's Popular Science Monthly* (New York) | Monthly | 2 6 | — | — |
| *Proc. Phys. Soc.* (Lond.) | *Proceedings* of the Physical Society of London | — | 2 6 | — | — |
| *Proc. Roy. Soc.* (Edin.) | *Proceedings* of the Royal Society of Edinburgh | — | Varies | — | — |
| *Proc. Roy. Soc.* (Lond.) | *Proceedings* of the Royal Society of London | — | Varies | — | — |
| *Rend. Acc. Linc.* | *Rendiconte Atti della Reale Accademia dei Lincei* (Italy) | Semi-monthly | — | — | — |
| *Rend. Acc. Sci. Fis. e Mat.* | *Rendiconti della Reale Accademia della Scienze fisiche e Matematiche di Napoli* (Italy) | — | — | — | — |
| *Science* | *Science* (New York) | Weekly | 0 10 | — | — |
| *Science Prog.* | *Science Progress* (London) | Quarterly | 3 0 | — | — |
| *Sitz.-ber. Wurzb. Phys.-med. Ges.* | *Sitzungsberichte der Würzbürger Physikalisch-medicinischen Gesellschaft* (Germany) | — | — | — | — |
| *Ver. Phys. Ges.* | *Verhandlungen der Physikalischen Gesellschaft zu Berlin* | — | — | — | — |
| *Wied. Ann.* | *Wiedemann's Annalen der Physik und Chemie* (Leipzig) | Monthly | 3 0 | 1 16 0 | 1 16 0 |
| *Wien. Ber.* | *Sitzungsberichte der Kaiserlicken Akademie der Wissenschaften* (Vienna) | — | — | — | — |
| *Zeit. f. Elek.-chem.* | *Zeitschrift für Electrochemie* (Halle, Germany) | Fortnightly | 0 8 | 0 16 0 | 0 16 0 |
| *Zeit. f. Instrumk.* | *Zeitscerift für Instrumentenkunde* (Berlin) | Monthly | 1 9 | 1 0 0 | 1 0 0 |
| *Zeit. Phys. Chem.* | *Zeitschrift für Physikalische Chemie* (Leipzig) | Monthly | 4 9 | — | — |

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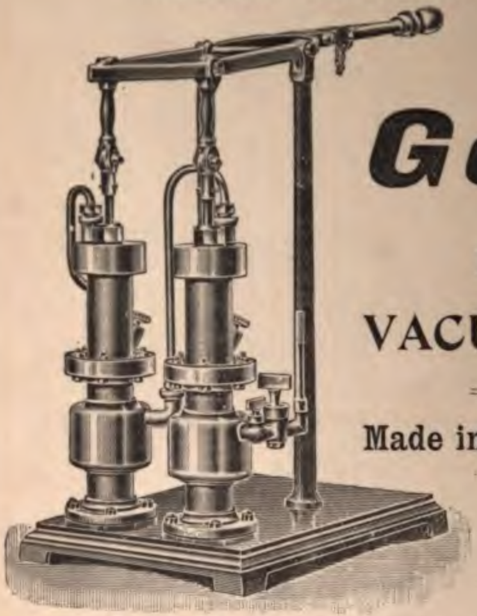

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# NOTE.

*A full explanation of the abbreviations used in the following entries will be found tabulated on pages xxxvi. and xxxvii.]*

*The letters and numbers within the brackets relate to the complete references, which will be readily found by means of the heavy type figures.*

◆

## A

**Abney, Capt., on the New Photography.** [N 2.]

**Absorption of Cathode Rays.** P. Lenard. *Wied. Ann.*, 56, pp. 255-275. 1895. **1**

**Absorption of Light Rays and Röntgen Rays by Crystallised Media.** M. G. Agafonoff. *C. R.*, 124, p. 855. 1897. **2**

The writer found that generally crystals which are transparent to luminous rays are opaque to Röntgen rays.

**Absorption, Selective, of Röntgen Rays.** [R 108.]

**Absorption of X-Rays by Gases and Vapours.** [E 10.]

**Absorptivity for Röntgen Rays.** V. Novák and O. Sulc. *Zeit. Phys. Chem.*, 19, pp. 689-492. 1896. **3**

**Accumulation of Light.** C. Henry and H. Becquerel. *C. R.*, 122, pp. 790-791. Two separate communications. **4**

**Ackroyd, W., and H. B. Knowles on Permeability of X-Rays.** [P 3.]

**Action of X-Rays upon the Diamond.** A. Buget and A. Gascard. *C. R.*, 122, p. 457. 1896. **5**

True diamonds are far more transparent to X-rays than are their imitations. The writers found that the same holds good for jet.

**Action of Röntgen Rays upon Electrostatic Charges and Discharge Potentials.** J. J. Borgman and A. L. Gershun. *C. R.*, 122, pp. 378-379. 1896. **6**

A zinc disc positively charged lost its charge under the influence of X-rays, and then acquired a negative charge of a certain fixed value.

**Adulteration of Food Stuffs, Detection of by X-Rays.** *Elec. Rev.* (Lond.), vol. 38, p. 593. **7**

**Adulteration and Röntgen Rays.** F. Ranwez. *C. R.*, 122, pp. 841-842. 1896. **8**

**Agafonoff, V., on Absorption of Light Rays and Röntgen Rays by Crystallised Media.** [A 2.]

**Air, Electrification of, by Röntgen Rays.** [K 3.]

**Air, Electrical Conductivity of, Affected by Röntgen Rays and Ultra-Violet Light.** [K 5.]

**Air, Propagation of X-Rays in.** [G 4.]

**Air Pump, Berrenberg Mechanical.** [B 19.]

**Air Pump, Duplex Mercurial.** [P 41.]

**Air Pump, the Geryk.** [P 42.]

**Air Pump, Kahlbaum's.** [K 1.]

**Air Pump.** *La Nat.*, No. 1,195, p. 333. **9**

An account of a rapidly-acting mercury fall-pump.

**Alternating Currents, a Crookes Tube for use with.** [C 20.]

**Alternating Currents and X-Rays.** Houston and Kennelly. *Am. Elec.*, vol. 8, No. 4, p. 117, 1896, and *Elec. Rev.* (Lond.), vol. 39, p. 325. **10**

Description of an arrangement (with diagram of connections) for utilising the current from an alternating current lighting circuit with a Tesla coil.

**American Notes.** *Elec.*, vol. 36, p. 668. 1896. **11**

A description of Shallenberger's results obtained by using a Tesla apparatus and only one pole connected direct to the exhausted tube.

**Animals, Effect of X-Rays upon.** Stefano Capranica. *Rend. Acc. Linc.*, 5, 1, pp. 416-417. 1896. Also note in *Nature*, vol. 54, p. 204. 1896. **12**

Observations made on mus musculus showed that X-rays had no effect upon the amount of $CO_2$ eliminated from the animal. Experiments on cold-blooded animals also gave negative results.

**Announcement of Prof. Röntgen's Discovery.** *Elec.*, vol. 36, p. 333. 1896. **13**

Quotes the *Standard* (Lond.) and comments thus :—"The whole phenomena seem likely to admit of a ready explanation when the conditions of the experiments are more fully published."

**Anode, Mercury.** [R 26.]

**Apparatus, A New Cathode.** [C 19.]

**Apparatus, New, for the Production of X-Rays.** BEN DAVIS. *Nature*, vol. 44, p. 281. 1896. **14**

Useful forms of experimental tubes and an account of fluoresence obtained through 3ft. of timber and also through a distance of 60ft. in air.

**Apparatus for Producing Röntgen Rays.** WILLYOUNG and SAYEN. *Elec. Rev.* (N.Y.), vol. 30, p. 51. **15**

**Apparatus, Röntgen Ray.** [R 78.]

**Apparatus, X-Ray, Manipulation of.** G. HANCHETT. *Elec. World*, vol. 29, p. 377. **16**

**Applications, Medical, of X-Rays.** [R 98.]

**Arc Light Rays, Shadow Pictures by.** [S 8.]

**Arc Light and Sunlight, Shadow Pictures from.** [S 7.]

**Armagnat, H., on Röntgen Tubes.** [R 119.]

**Arnold, W., on Cathode Rays and Röntgen Rays.** [C 9.]

**Arterial System Photographed by Röntgen Rays.** V. DUTTO. *Rend. Acc. Linc.*, 5, 1, pp. 129-130. 1896. **17**

The writer injected sulphate of calcium, which is a salt opaque to the rays, into the hand of a corpse. The solution was sufficiently dilute to penetrate into the small veins. The result was entirely satisfactory.

**Artificial Blende as a Source of X-Rays.** *C. R.*, 122, pp. 564-566. 1896. **18**

The writer found that transparent hexagonal blende, as prepared by himself and H. Saint-Claire Deville in 1861 (*C. R.*, 52, p. 983), will, after exposure to the sun or to magnesium light, act as does a Crookes tube. The blende is bandaged on to the part of the body to be photographed.

**Aubel, E. van, on Transparency to Röntgen Rays.** [T 22.]

## B

**Bacilli, Effect of X-Rays on.** *Nature*, vol. 54, p. 112. **1**

The State University of Missouri reports that X-rays cure diphtheria.

**Bacteria, Action of Röntgen Rays on.** Dr. SHRADER. *Elec. Eng.* (N.Y.), vol. 22, p. 176. 1896. **2**

The author found evidence of sterilising action.

**Bacteria, Röntgen Rays and.** F. MINCK. *Münch. Med. Woch.*, 43, p. 202. 1896. **3**

The rays were found to have no appreciable effect upon typhus bacilli in agar-agar medium.

Barr, J. M.: **An Experimental Vacuum Tube.** *Elec.*, vol, 37, p. 24. **4**

Description illustrated of a focus tube through the anode of which a current can be passed. The author finds it advantageous to reverse the direction of discharge in focus tubes.

Barr, J. M., and Phillips, C. E. S., **on Deflection of Cathode Rays.** (First communication). *Elec.*, vol. 38, p. 498. [See also B 6. **5**

The authors describe experiments in which they passed electric currents of from 20 to 30 amperes through anti-cathodes of various forms, and observed the distortional effects produced by so doing upon the cathode shadows. They also passed currents through the cathode itself, with the result that the cathode shadow cast by a free anti-cathode was totally translated in a direction opposite to that in which the current flowed.

Barr, J. M., and Phillips, C. E. S., **on Deflection of Cathode Rays.** (Second communication). *Elec.*, vol. 38, p. 530. [See also B 5, T 8, and D 3.] **6**

In which the authors deal with cathode shadow movements under various electrostatic conditions.

Barr, J. M., and Phillips, C. E. S., **Letter from, on Deflection of Cathode Rays.** *Elec.*, vol. 38, p. 357. **7**

The writers suggest the possibility of using a current-carrying coil placed behind the cathode as a means of making very short exposures of a sensitive photographic plate to X-rays. They also point out that under certain conditions such a coil so placed greatly diminishes the spark resistance of a focus tube during excitation.

Barr, J. M., and Phillips, C. E. S.: **A New Vacuum Gauge.** *Elec.*, vol. 37, p. 828. [See also P 4.] **8**

An application of the principles stated by PERRIN.

Basilewski **on Reduction of Exposure in Röntgen Photography.** [R 12.]

Battelli, A., **on Röntgen Rays.** *N. Cim.*, April, 1896, p. 193, and *Elec. Rev.* (Lond.), vol. 38, p. 758. **9**

By means of cylinders of sensitive films placed inside the Crookes tube, the author found that photographic action was most marked on that part which faced the cathode. He deflected the cathode pencil by means of a magnet, but still obtained photographic effects, although slightly diminished, showing that some photographic rays other than cathode rays (as generally understood) were emitted from the cathode. The article is fully illustrated.

Battelli, A., and A. Garbasso **on Röntgen Rays.** *N. Cim.*, 4, 3, pp. 40-41, 1896. **10**

The authors describe numerous experiments made with the rays, relating to the behaviour of the Crookes tube. They also investigated the transparency of various materials and give results. The writers point out that the curve plotted, between density and transparency as ordinates, is roughly a parabola.

Battelli, A., and A. Garbasso **on Shortening Necessary Exposure to X-Rays.** [S 10.]

**Battelli, A., on Source of Röntgen Rays.** [S 14.]

**Beaulard, F., on Refraction of Röntgen Rays.** [R 17 and 18.]

**Becquerel, H., and C. Henry on Accumulation of Light.** [A 4.]

**Becquerel and Sagnac, Experiments on Invisible Radiations.** [R 1.]

**Becquerel Rays.** A. F. McKissick. *Elec.*, vol. 38, p. 313. **11**
Fluorescence of various substances after exposure to sunlight; good photographic results obtained through 2½in. of wood by means of granulated sugar.

**Becquerel Rays.** *C. R.*, 122, pp. 559-564. **12**
The rays from certain uranium salts, particularly potassium-uranic-sulphate, will traverse black paper, aluminium and copper. They discharge electrically charged bodies.

**Becquerel on Radiation from Metallic Uranium.** *C. R.*, 122, pp. 1,086-1,088. 1896. **13**

**Becquerel Rays and Röntgen Rays Provoke Thermo-Luminescence.** [B 27].

**Bending of X-Rays.** E. Villari. *Rend. Acc. Linc.*, 5, 1, pp. 445-452. 1896. **14**
Details of experiments to show that X-rays bend round solid objects.

**Benoist, L., on Transparency of Gases to Röntgen Rays.** *C. R.*, 124, p. 146. 1897. [See also O 5.] **15**
The writer found that with solids the opacity does not increase with density. Experiments were made in which it was shown that with gases the absorption is proportional to the density, and that this diminishes rapidly as the temperature rises.

**Benoist, L., and D. Hurmuzescu on Action of X-Rays on Electrified Bodies.** *C. R.*, 122, pp. 779-782. 1896. **16**

**Benoist, L., and D. Hurmuzescu on Röntgen Rays and Electric Charges.** [E 4.]

**Benoist, L., and D. Hurmuzescu on New Properties of X-Rays.** [X 15.]

**Berlin, Formation there of Scientific Photographic Society for Investigating Optical Phenomena.** *Elec.*, vol. 36, p. 435. **17**

**Berliner, E.: Wooden Cylinder for X-Ray Lamp.** *Elec. Rev.* (Lond.), vol. 40, p. 327. **18**
The arrangement of a wood cylinder slipped over the tube containing the cathode to discharge the outside electrostatic charge and so prevent the increase of the vacuum within the tube.

**Berrenberg Mechanical Air Pump.** *Elec. Rev.* (Lond.), vol. 38 p. 103. **19**

An illustrated account of the apparatus.

**Biological Action of X-Rays.** [A 12.]

**Birkeland, M.: Cathode Ray Spectrum.** *C. R.*, 13, vol. 123. **20**

An account of experiments which show evidence that the cathode pencil is heterogeneous.

**Birkeland, M., on the Effects of Strong Magnetic Forces on Cathode Rays.** [C 10.]

**Bleekrode, L., on Röntgen Rays at Low Temperatures.** [R 97.]

**Blende, Artificial, as a Source of X-Rays.** [A 18.]

**Bleunard and Labesse, MM., on Opacity of Liquids and Solids to X-Rays.** [O 6.]

**Blindness and X-Rays.** *Elec.*, vol. 38, p. 325, also p. 291. **21**

Correspondence on the possibility of restoring, partially or completely, sight to the blind.

**Blythswood, Lord, Photographs obtained with large Wimshurst Machine, and without a Crookes Tube.** *Elec.*, vol. 36, p. 559. **22**

A letter descriptive of the experiments. [Also P 32, X 18.]

**Blythswood, Lord, on Reflection of X-Rays.** [R 14.]

**Boas, H., on Tubes for Röntgen Rays.** [T 31.]

**Boltzmann, L., on Longitudinal Waves.** *Jour. f. Gasbeleuchtung*, 39, pp. 71-72, 1896. **23**

The writer is of the opinion that the Röntgen rays are longitudinal waves propagated in the ether.

**Boltzmann, L., on Röntgen's Epoch-Making Discovery.** *Zeit. f. Elec.*, Jan. 15, 1896. **24**

**Bonn, M. le, Photographic Action of Ordinary Light through seemingly Opaque Bodies.** *C. R.*, Feb. 3, 1896, p. 233. [See also D 1.] **25**

**Borgman, J. J., Electrical Discharge by X-Rays.** *Elec.*, vol. 36, p. 501. **26**

A telegram in which Prof. BORGMAN says Röntgen rays discharge rapidly positive electricity, slower negative. At short distances they give negative electrification. They increase spark gap. [For other experiments on spark gap see C 11.] Aluminium does not hinder either action.

Borgman, J. J., on Thermo-Luminescence provoked by Röntgen Rays and Becquerel Rays. *C. R.*, No. 17, p. 895. 1897. **27**

The author used a calcined mixture of $CaSo_4+50\%$ of $MnSo_4$, and obtained vigorous thermo-luminous effects with Röntgen rays and with Becquerel rays.

Borgman, J. J., and A. L. Gershun on Action of Röntgen Rays on Electrostatic Charge and Discharge Potentials. [A 6.]

Bouchard, L., on Consumption and X-Rays. [C 17.]

Brandes, G., on Visibility of Röntgen Rays. [V 5.]

Branson on Method of Estimating the Intensity of X-Rays. [I 4.]

Brissaud and Londe, MM., on X-Ray Photography. [P 23.]

British Association Meeting. *Nature*, vol. 54, p. 565. **28**

Account of work by various members.

Brush Discharge, Röntgen Rays from. [R 80.]

Buget, A., and A. Gascard on the Action of Röntgen Rays on Diamonds. [A 5.]

Buget, A., and A. Gascard on Action of X-Rays on Precious Stones. [P 34.]

Buget, A., and A. Gascard on Transparency of Diamonds to X-Rays. [D 8.]

Bungetziano on Diffraction of Röntgen Rays. [R 81.]

Burke, J., Experiments with X-Rays. *Elec.*, vol. 37, p. 373. **29**

Relates to charging and discharging effects of the rays.

## C

Caffrey, W., and N. S. Wilson on Medicinal Properties of X-Rays. [X 12.]

Cajori, F., Solar X-Rays on Pike's Peak. *Am. Jnl. of Science*, 1, 1896, p. 289. **1**

After careful experiments at a height of 14,147ft. no trace of Röntgen rays was found.

Calmette, L., and G. T. Lhuillier on Diffraction of Röntgen Rays. [D 9.]

Campanile, F., and E. Stromei on Phosphorescence and Röntgen Rays. [P 9.]

Campanile, F., and E. Stromei on X-Rays in Geissler and Crookes Tubes. [P 8.]

Capranica, Stefano, on Biological Action of X-Rays. [A 12.]

**Carpentier, J., on Photographing the Relief of a Medal by Röntgen Rays.** [P 22.]

**Cathode Apparatus, A New.** [C 19.]

**Cathode Disc, Rotation of in Crookes Tube.** [N 7.]

**Cathode Photography.** E. J. WALL. *Brit. Jnl. of Phot.*, vol. 43, p. 87. **2**
A brief history of cathode ray work to HERTZ and LENARD.

**Cathode Rays, J. Puluj on.** [P 39.]

**Cathode Rays.** CH. GUILLAUME. *La Nat.*, No. 1,187, p. 194. [See also *La Nat.*, No. 1,177, p. 42.] **3**
An article on the nature of cathode rays.

**Cathode Rays.** G. JAUMANN and H. POINCARÉ. *C. R.*, 122, pp. 74-76, 1896. **4**
A discussion of the theory of cathode rays.

**Cathode Rays.** T. DES COUDRES. *Ver. Phys. Ges.*, Berlin, pp. 85-87, 1895. **5**

**Cathode Rays, Absorption of.** [A 1.]

**Cathode Rays, Coloration of Salts by.** [C 12.]

**Cathode Rays, Deflection of, by Electrostatic Fields.** [D 3.]

**Cathode Rays, Deflection by Magnetic Fields.** [D 2.]

**Cathode Rays in an Electric or Magnetic Field.** A. GARBASSO. *Rend. Acc. Linc.*, 5, 2, pp. 250-253, 1895. **6**
HERTZ found no deviation of cathode rays in passing through an electrostatic field, but JAUMANN has lately produced feeble cathode rays which do become curved under these conditions. This may be explained by the charged particle theory.

**Cathode Rays, Experiments with.** A. W. WRIGHT. *Am. Jnl. of Science*, vol. 1, 4th series, p. 235. **7**
The authors endeavoured to prove the existence of mutual repulsion between two cathode beams, and their deviation in a magnetic field. A pair of slits were cut in a copper screen placed in front of the cathode so that the pencils of rays were emitted and allowed to fall upon a sensitive plate placed at an angle to the copper screen. The resulting photograph showed that the pencils were divergent, also a slightly repulsive action was observed. The writer also endeavoured to introduce metal in a fine state of division into the cathode rays by interposing gold leaf in the path ; the result was that photographs showed that repulsion had taken place to a more marked extent.

**Cathode Rays, Longitudinal Tension of.** [L 21.]

**Cathode Rays, Reflection of.** G. SÉGUY. *C. R.*, 122, p. 134, 1896. Also *l'Elec.*, 11, pp. 300-301, 1896. **8**

**Cathode Rays, A Residual Photo-Electrical Effect of.** [R 22.]

**Cathode Rays and Röntgen Rays.** W. Arnold. *Zeit. f. Elektchem.*, pp. 602-604, 1896. **9**
Fluorescence experiments.

**Cathode Rays and X-Rays: a Comparison.** [L 6.]

**Cathode and X-Rays, Distinction between them.** [G 1.]

**Cathode Rays under the Influence of Strong Magnetic Forces.** M. Birkeland. *Elek. Zeit.*, April 20, 1896. Also *Elec. Rev.* (Lond.), vol. 38, pp. 752-782. **10**
The author treats the subject very fully, and particularly refers to the effect of the magnets upon cathode shadows. He mentions the conversion of cathode rays into X-rays by means of a magnet.

**Cattell, H. W., on X-Rays in Surgery.** [S 36.]

**Cave, C. J. P., Experiments with Spark Gaps.** *Elec.*, vol. 36, p. 559. [See also B 26.] **11**
A letter in which the writer describes experiments undertaken to verify Borgman's results on the effect of X-rays upon a spark gap. For a constant gap he found that the number of sparks passing per minute was greater under X-rays than when the rays were screened off with a zinc plate.

**Chabaud, V., on Röntgen Rays.** [R 31.]

**Chabot, J. T., on Röntgen Rays.** [R 32.]

**Chappuis, J., on Exposure in Röntgen Photography.** [E 21.]

**Chappuis, J., and E. Nugues on Maximum Power of Crookes Tube.** [C 23.]

**Charge, Electrical, on Anti-Cathode: Effect on Cathode Shadow.** [T 8; also *Nature*, vol. 54, p. 566; also B 5 and 6.]

**Charging, Electric, by Röntgen Rays.** [R 89.]

**Chemical Nature of Bodies: Relations between, and their Opacity to X-Rays.** [R 20.]

**Colard, M., on Longitudinal Tension of Cathode Rays.** [L 21.]

**Colardeau, M. E., on a New Form of Crookes Tube for Short Exposures.** [C 21.]

**Colle, F. S.: A New Fluorescent Screen.** [F 9.]

**Coloration of Salts by Cathode Rays.** E. Goldstein. *Berl. Ber.*, 45, pp. 1,017-1,024. 1895. **12**

**Colson, R., on Photographic Films.** *C. R.*, 122, pp, 598-600. 1896. **13**

Photographic gelatine films are affected by, amongst other causes, mechanical pressure and friction.

**Condensation, Cloudy, Effect of X-Rays on.** C. Wilson, *Proc. Roy. Soc.* (Lond.), vol. 59, p. 338. **14**

The author found that when air was sufficiently expanded to give under ordinary conditions a sufficient fall of temperature to produce a shower of fine rain, that the passage of Röntgen rays caused the formation of a persistent fog.

**Condenser, Electrostatic, and Röntgen Rays.** [R 91.]

**Condenser Method for Producing X-Rays.** C. L. Norton and R. R. Lawrence. *Science*, vol. 5, p. 496. **15**

The authors worked their induction coil through a condenser off lighting mains at 220 volts, and claim that the result gives a more powerful means of working than any other: shadows being obtained through the densest portions of the human trunk. The discharging of the condenser is effected by means of a 5-part commutator on the shaft of a small motor and discharges 250 times per second without any sensible sparking.

**Consumption and Röntgen Rays.** *Elec. Eng.* (N.Y.), vol. 22, p. 87. 1896. **16**

An account of several successful experiments.

**Consumption and Röntgen Rays.** L. Bouchard. *C. R.*, 123, p. 1,234. 1896. [See also T 36, 37 and 38.] **17**

The writer found the right lung of a patient gave a much deeper shadow than the left, and the prediction, therefore, that it was filled with tubercles was subsequently verified.

**Contact, Electricity, of Metals, Effect of X-Rays on.** [R 87.]

**Convection of Electricity Produced by Röntgen Rays.** A. Righi. *Rend. Acc. Linc.*, 5, 1, pp. 452-455, 1896. **18**

Description of experiments to show that electric discharge produced by X-rays takes place in the direction of the lines of force.

**Cormack, J., and H. Ingle on the Opacity of Bone to Röntgen Rays.** [O 2.]

**Cottier, Jos., on Photography in Vacuo.** [P 26.]

**Coudres, T. des, on Cathode Rays.** [C 5.]

**Courmelles, Foureau de, and G. Séguy, on Experiments with a New Cathode Apparatus.** *C. R.*, 124, p. 814. 1897. **19**

A description of a new form of apparatus consisting of two vacuum tubes connected to a spherical reservoir. Each tube contained an anode and anticathode placed in the same axis. The writers describe some interesting effects of charge distribution obtained with the apparatus in operation.

**Courtenay, G. R.: Photography by Heat Rays.** [P 18].

**Crookes Apparatus, A.** [P 5.]

**Crookes Tube for use with Alternating Currents.** MM. Oudin and Barthélemy. *C. R.*, 123, p. 1,269, 1896. **20**

A description of a well-designed tube giving a steady light with an alternating current.

**Crookes Tube, On a Form of, for Short Exposures.** M. E. Colardeau. *C. R.*, vol. 5, 3rd series, p. 542, 1896. **21**

The writer states the conditions necessary to be fulfilled to obtain the above, and describe a form of tube used by him with excellent results.

**Crookes Tubes.** C. Hutchins and F. Robinson. *Am. Jnl. of Science*, 1, pp. 463-466, 1896. **22**

Practical hints.

**Crookes Tube, Maximum Power of.** J. Chappuis and E. Nugues. *C. R.*, 122, pp. 810-812. 1896. **23**

With the particular induction coil employed the maximum Röntgen radiation was reached with 10 breaks per second.

**Crookes Tubes, Mechanical Action from.** [M 9.]

**Crookes Tubes, Occlusion in.** [O 1.]

**Crookes Tubes.** L. Segalin. *N. Cim.*, 4, 3, pp. 209-212. 1896. **24**

The writer points out the beneficial effect of reversing the direction of the discharge in a Crookes tube. He found also that when the rarefaction of the gas within the tube had become too high it was an advantage to heat the cathode disc with concentrated rays from the sun.

**Crookes Tubes.** E. Semmola. *Rend. Acc. Sci. Fis. e Mat.* (Naples), June-July. 1896. **25**

A Crookes tube with a band of tinfoil near the cathode, and put to earth, gave a brighter light and more abundant Röntgen radiation.

**Crookes Tubes.** Q. Sestini. *N. Cim.*, 4, 3, pp. 65-73. 1896. **26**

Mentions the falling-off in power of a Crookes tube after much use.

**Crookes Tubes.** E. Villari. *Rend. Acc. Linc.*, 5, 1, pp. 377-388. 1896. **27**

The whole interior of the tube is charged negatively near the cathode and where the cathode rays strike, but more powerfully in the latter case and over areas of lesser illumination. The charge is liable to reverse, so that its distribution is rendered complicated.

**Cryptochroism.** A. Ròiti. *Mem. Acc. Linc.*, 5A, vol. 2. 1896. **28**

The article describes an actinometer for X-rays designed after Ritshie's photometer.

**Cryptochroism.** A. Ròiti. *Rend. Acc. Linc.*, 5, 2, pp. 153-155. 1896. **29**

**Czermak, P., On Stereoscopic Radiography.** [S 26.]

# D

**Darien and De Roches, MM., on Invisibility of Röntgen Rays.** [I 5.]

**Dark Light.** M. Le Bon. *C. R.*, Jan. 27, 1896, p. 188.; *Phil. Mag. Abs.*, vol. 41, p. 235. **1**

Photographs obtained by means of ordinary light through what are generally considered opaque bodies.

**D'Arsonval on Photography through Opaque Bodies.** [P 21.]

**Davis, Ben: New Apparatus for Producing X-Rays.** [A 14.]

**Deflection of Cathode Rays by Magnetic Fields.** J. A. Fleming, F.R.S. *Elec.*, vol. 38, p. 302. **2**

Rotation and diminution of shadow on passing a current through a coil encircling the tube, and ultimate disappearance of shadow on increasing the current; on still further increasing the current, a second but fainter shadow appeared, larger than the first one; a further increase again of the current produced a diminution of the shadow, but no rotation.

**Deflection of Cathode Rays.** [B 5 and 6.]

**Deflection, Electrostatic, of Cathode Rays.** G. Jaumann. *Wiener Sitzungsber.*, 105, 2a, April, 1896. Trans. in *Elec.*, vol. 37, p. 343. [B 5 and 6.] **3**

An account of experiments in which it is shown that not only do external magnetic fields deflect cathode rays, but also external electrostatic fields. It was necessary to employ a feeble pencil of rays, and the effects were difficult to observe. Mention is made of the behaviour of different parts of the cathode beam under these conditions.

**Deflection, Magnetic, Imparted to Röntgen Rays.** [I 2.]

**Dermatitis from Exposure to Röntgen Rays.** Dr. H. Crocker. *Brit. Med. Jour.*, vol. 1, p. 8. 1896. **4**

Details of the case, with coloured illustration.

**Dery-Develshauvers on Reflection of Röntgen Rays.** *Beiblätter*, No. 20, p. 809. **5**

The writer concludes:—(1) There is no true reflection, that the diffusive reflection recorded by various writers is caused, at least partly, by the generation of rays in the substances experimented upon, which are different to X-rays. (2) That geometrical reflection does not exist for Röntgen rays.

**Dewar, J., on Opacity to X-Rays.** Note in *Elec.*, vol. 36, p. 537. **6**

In which he agrees that opacity increases with atomic weight, not with density only, as stated by Röntgen.

**Diagnosis by X-Rays.** Rev. T. E. Espin. *Photography*, vol. 9, p. 73. **7**

The author found that diseased bones are much more transparent than healthy ones.

**Diagnosis of Disease by Means of X-Rays.** [D 19.]

**Diamonds, Action of Röntgen Rays on.** [A 5.]

**Diamonds and X-Rays.** Abel Buget and Albert Gascard. *La Nat.*, No. 1,195, p. 293. **8**

An account of experiments to show that diamonds are transparent to X-rays. The article is illustrated.

**Dielectric, Function of, in X-Ray Discharge Effects.** [D 15.]

**Diffraction of Röntgen Rays.** [R 81.]

**Diffraction of Röntgen Rays.** L. Calmette and G. T. Lhuillier. *C. R.*, 122, pp. 877-878. 1896. **9**

A reason for supposing X-rays to have a wave-length greater than that of light.

**Diffusion and Opalescence with Röntgen Rays.** Elihu Thomson. *Elec. World*, vol. 27, p. 452. (See also *ibid.*, p. 488.) **10**

The author found that certain bodies behave with X-rays as opal glass and milky liquids do with ordinary light.

**Diffusion of Röntgen Rays.** A. Imbert and H. Bertin-Sans. *C.R.*, 122, pp. 524-525. 1896. **11**

**Diphtheria Cured by X-Rays.** [B 1.]

**Discharge, Electric, in Magnetic Field.** [M 5.]

**Discharge, Electric, Effect of Light and Röntgen Rays on.** [M 14.]

**Discharge, Electric, and Photographic Action by Röntgen Rays.** [E 5.]

**Discharge, Electrical, by means of X-Rays.** J. J. Borgman. *Elec.*, vol. 36, p. 501. [See B 26 and R 23.] **12**

**Discharge, Electrical, by means of X-Rays.** J. J. Thomson. (A letter). *Elec.*, vol. 36, p. 491. **13**

**Discharge, Electrical, by X-Rays.** [T 11.]

**Discharge, Electrical, by X-Rays, Rate of.** [T 13.]

**Discharge, Phenomena, in Rarefied Metallic Vapours.** E. Weidemann and G. C. Schmidt. *Weid. Ann.*, 57, p. 454. 1896. Trans. in *Elec.* begins vol. 36, p. 851. **14**

**Discharge by Röntgen Rays, Function of the Dielectric.** J. Perrin. *C. R.*, vol. 123, p. 351. [Also B 8.] **15**

In which the author shows the rate of discharge produced by passing X-rays between two plates, depends upon the dielectric between them.

**Discharge by Röntgen Rays.** [R 82.]

Discharge by Röntgen Rays. *l'Eclair. Elec.*, 7, pp. 545-549. 1896. **16**

The writer points out that not only do the rays discharge a charged body within an enclosure, but also the opposite charge upon the walls of the enclosure.

Discharge by Röntgen Rays. E. Villari. *Rend. Acc. Linc.*, 5, 2, pp. 419-429. 1896. **17**

Discharge by Röntgen Rays or Electric Sparks. E. Villari. *Rend. Acc. Linc.*, 5, 2, pp. 281-293. 1896. **18**

The property of discharging charged bodies acquired by gases when Röntgen rays are passed through them persists after the gases have traversed tubes up to ten metres long, but falls off after this length is exceeded. An induced electric spark confers similar properties. The discharging power induced in a gas was made to traverse long tubes. The material of the tubes made little or no difference.

Discharge by Röntgen Rays: the Part Played by the Surface Acted upon. [P 4.]

Disease, Diagnosis of, by means of X-Rays. C. L. Norton. *Elec. World*, vol. 27, p. 603. **19**

A letter in which the writer details several cases of correct diagnosis.

Diselectrification of Solids Produced by X-Rays and by Flame. [K 4.]

Dispersion, Electric, Produced by Röntgen Rays. [E 6.]

Dissociation, Molecular, of Electricity by Röntgen Rays. [M 18.]

Distinction between Cathode and X-Rays. [G 1.]

Doelter, C., on Röntgen Rays. [R 33.]

Dolbear, A. E.: Röntgen Rays. [R 34.]

Dolley, C. S., and S. Egbert: Röntgen Rays in Sunlight. [S 35.]

Donati, L., on Electric Discharge and Photographic Action by Röntgen Rays. [E 5.]

Dufour, H., on Properties of X-Rays. [P 36.]

Duration of Emission of Röntgen Rays. [R 86.]

Duration of X-Radiations for each Spark. [T 24.]

Dutto, V., on Photography of Arterial System by Röntgen Rays [A 17.]

## E

**Eder, J. M., and E. Valenta on Röntgen Rays.** [R 85.]

**Edison's (T. A.) Fluoroscope.** *Elec. Rev.* (Lond.), vol. 38, p. 534; also *Elec. World*, vol. 27, p. 360. **1**

**Edison, T. A., on Lamps for Röntgen Rays.** [L 2.]

**Edison's (T. A.) Röntgen Ray Work.** E. J. Houston and A. E. Kennelly. *Elec. World*, vol. 27, p. 308. **2**

Illustrated forms of tubes, and his conclusions as to the best apparatus and conditions for work.

**Edwards, Dr. Hall: Notes on Radiography.** *Brit. Jnl. of Phot.*, vol. 43, p. 374. **3**

An account of radiographs obtained through 6, 7 and 10 layers of pen-steel, sheet-copper and 7 layers of sheet-lead. Tube used was made by Mr. Cossor, and required 11½in. spark, exposure five minutes.

**Effects, Electric, of X-Rays.** [E 7.]

**Electric Charging by Röntgen Rays.** [R 89.]

**Electric Charges and Röntgen Rays.** L. Benoist and D. Hurmuzescu. *C. R.*, 122, pp. 926-927. 1896. **4**

Rate of discharge by X-rays increases rapidly with the density of the surrounding gas or air. It varies directly as the square root of the density.

**Electric Discharge and Photographic Action by Röntgen Rays.** L. Donati. *N. Cim.*, 4, 4, pp. 164-166. 1896. **5**

The writer describes experiments which lead him to state that there is a constant ratio between the discharging action and the photographic action of the rays.

**Electric Dispersion produced by Röntgen Rays.** A. Righi. *Rend. Acc. Linc.*, 5, 1, pp. 342-348. 1896. **6**

The writer concludes from his experiments that a non-gaseous dielectric does not become a conductor under the influence of Röntgen rays.

**Electric Effects of X-Rays.** A. Righi. *C. R.*, 122, pp. 601-602. 1896. **7**

X-rays discharge electrified conductors as well as non-conductors, and always give an ultimate positive charge. X-rays arrest the movements of a radiometer vane, but not if no electric charge is allowed to develope on the glass. The dispersion of electric charge on the glass is less in rarefied air, while the positive potential ultimately attained is higher.

**Electric or Magnetic Field, Cathode Rays in.** [C 6.]

**Electric Sparks, Discharge by, and by Röntgen Rays.** [D 18.]

**Electric Sparks and Ultra-Violet Light.** [U 1.]

**Electric Sparks, Action of Röntgen Rays on.** A. Sella and Q. Majorana. *Rend. Acc. Linc.*, 5, 1, pp. 323-327; also pp. 389-392. 1896. **8**

At short distances sparking between two points was favoured by letting Röntgen rays fall upon the negative pole. The writers discuss the matter fully.

**Electric Sparks, Explosive Distance of, Effect of X-Rays on.** [G 9.]

**Electrical Phenomena of Röntgen Rays.** A. Righi. *N. Cim.*, 4, 3, pp. 177-188. 1896. **9**

An account to date of work done in this direction.

**Electricity, Distribution of, on Surface of Crookes Tube.** [V 3.]

**Electricity, Passage of, through Röntgenised Gases.** [T 14.]

**Electricity, Transport of by Röntgen Rays.** [R 114.]

**Electrification of Air by means of X-Rays.** [K 3.]

**Electrification of Gases exposed to Röntgen Rays, and the Absorption of X-Rays by Gases and Vapours.** E. Rutherford. *Phil. Mag.*, vol. 43, p. 255. [Also G 4.] **10**

Results of a series of carefully arranged experiments on above, with a table of conductivities of various gases.

**Electrification and Light.** [L 13.]

**Electrified Bodies, Effect of Röntgen Rays on.** [B 16.]

**Electrified Röntgen Rays.** A. Lafay. *C. R.*, 122, pp. 929-932. 1896. [See also L 17.] **11**

Experiments in which the rays are made to carry an electric charge.

**Electrified Röntgen Rays.** A. Lafay. *C. R.*, 122, pp. 837-839. 1896. **12**

The results referred to in **I** 2 and **E** 13 are not due to a joint action of a magnetic and an electric field.

**Electrified Röntgen Rays.** A. Lafay. *C. R.*, 122, pp. 809-810. 1896. **13**

A continuation of work published previously upon magnetic deviation (see **I** 2). The direction of the deviation depends upon the sign of the electrification. The author also mentions in passing that a Crookes tube can be rejuvenated by heating it to 200°C.

**Electro-Chemical Action of Röntgen Rays.** Franz Streinitz. *Weiner Berichte*, Feb. 6, 1896. Abs. in *Phil. Mag.*, vol. 41, p. 462. **14**

The author points out that X-rays alter the electrical conductivity of the silver haloids. The article deals with photo-electric experiments.

**Electrographs.** J. I'ANSON. *Nature*, vol. 55, p. 269. 1897. **15**

Patterns produced by charged conductors; images obtained by electric discharges to coins without other apparatus.

**Electrography.** JULES ROBINET and AUGUSTE PERRET. *La Nat.*, No. 1,197, p. 353. **16**

Photographs obtained by placing sensitive plate between metal sheets connected to an induction coil.

**Electrostatic Forces, Velocity of Propagation of.** Lord KELVIN. *Nature*, No. 1,371, Feb. 6, 1896, p. 316. **17**

**Electrostatic Charge and Discharge Potentials, Effect of Röntgen Rays on.** [A 6.]

**Elster, J., and H. Geitel on Electro-Optical Investigation of Polarised Light.** *Ann. Phys. Chem.*, Bd. 55, trans. in *Phil. Mag.*, vol. 41, p. 218. **18**

**Elster, J., and H. Geitel: Residual Photo-Electric Effect of Cathode Rays.** [R 22.]

**Emission Point of Röntgen Rays.** [R 101.]

**Emission of Röntgen Rays by a Tube containing Fluorescent Matter.** N. PILTSCHIKOFF. *C. R.*, 122, pp. 500-501. 1896. **19**

**Energy of Röntgen Rays.** [T 26.]

**Engelmeyer, P. K. de, on Invisible Rays.** [I 6.]

**Excitation, Luminous.** [L 23.]

**Explosive Discharge in Air, Action of Röntgen Rays and Ultra-Violet Light on.** A. SELLA and Q. MAJORANA. *l'Eclair. Elec.*, vol. 10, pp. 36-37. **20**

**Exposure to Röntgen Rays, Shortening of.** [S 10.]

**Exposure, Photographic, Reduction of, in X-Ray Work.** [S 42.]

**Exposure, Reduction of, in Röntgen Photographs.** MESLIN. [R 11.]

**Exposure, Reduction of, in Röntgen Photography.** BASILEWSKI. [R 12.]

**Exposure in Röntgen Photography.** J. CHAPPUIS. *C. R.*, 122, pp. 777-779. 1896. **21**

**Eye, the, Transparency of to X-Rays.** M. WUILLOMENET. *C. R.*, 122, pp. 727-728. 1896. **22**

A rabbit's eye containing a pellet of lead was photographed, and the image of the lead could be clearly seen in the resulting negative.

## F

**Faè, G., on Röntgen Rays.** [R 36.]

**Ferrotype Plates for X-Ray Work.** O. Lodge. *Elec.*, vol. 36, p. 865. **1**

**Films, Photographic.** [C 13.]

**Firefly Rays.** H. Muraoko. *Weid. Ann.*, vol. 59, p. 773; also *Elec. Rev.* (Lond.), vol. 39, p. 804. **2**

**Fitzgerald, G. F.: Longitudinal Component of Light.** *Phil. Mag.*, vol. 42, p. 260. **3**

**Flame, Coal Gas, Transparency of to X-Rays.** [P 7.]

**Flame, Diselectrification of Solids by, and also by X-Rays.** [K 4.]

**Fleming, J. A., on Deflection of Cathode Rays by Magnetic Fields.** [D 2.]

**Fluorescence.** G. C. Schmidt. *Weid. Ann.*, 58, pp. 103-130. 1896. **4**

**Fluorescence, X-Ray, Colour of.** P. C. McIlkiney. *Elec. World*, vol. 28, p. 664. **5**

Abstract of Paper read before N.Y. Academy of Science, Nov. 2, 1896.

**Fluorescence, Experiments on.** Elihu Thomson. *Elec.*, vol. 38, p. 302. **6**

**Fluorescence of Glass in X-Ray Photography.** [S 3.]

**Fluorescence, Polarised.** [P 31.]

**Fluorescence of Solids and "Solid Solutions."** E. Wiedemann and G. C. Schmidt. *Weid. Ann.*, 56, pp. 201-254. 1895. **7**

**Fluorescence of Vitrified Materials under the Action of Röntgen Rays.** M. Radiquet. *C. R.*, 124, p. 179. **8**

A number of substances become luminous under the influence of X-rays, including the following, arranged in decreasing order :—Baked enamels, crown flint glass, porcelain, enamel powder (before baking) and cut diamond.

**Fluorescent Bodies Produce Extension of Visible Spectrum.** [S 38.]

**Fluorescent Screen, A New.** F. S. Colle. *Elec. Rev.* (Lond.), vol. 40, p. 356. **9**

The author employed a preparation of oxyfluoride of auranium and ammonia ($Ur_2O_2H_24NH_4Fl$), and gives instructions for setting up such a screen.

**Fluorescing Screens, Best Way of Making.** E. P. Thompson. *Elec.*, vol. 36, p. 668. **10**

**Fluoroscope, Edison's.** *Elec. Rev.* (Lond.), vol. 38, p. 534. **11**

**Fluoroscope, H. O. Mance's, for Testing the Efficiency of X-Ray Tubes.** *Elec. Rev.* (Lond.), vol. 38, p. 760. **12**

**Focus Tube for Alternating Currents.** [S 39.]

**Focus Tube for X-Rays.** *Elec. Rev.* (Lond.), vol. 38, p. 340. **13**
An account of Jackson's focus tube (illustrated).

**Focus Tube for X-Rays, Note on.** R. W. Wood. *Phil. Mag.*, vol. 41, p. 382. **14**
An account of a tube in which the heating effect produced by the cathode rays beating upon the glass is partially obviated.

**Fog Produced by X-Rays.** [C 14 and S 25.]

**Fomm, L.: Wave lengths of Röntgen Rays.** *Weid. Ann.*, vol. 59, p. 350. 1896. **15**
By means of diffraction gratings he obtains 0·000014mm. as the probable wave-length of X-rays. Sagnac has made it 0·00004mm. as a superior limit.

**Fontana, A., and A. Vmani on Action of Röntgen Rays upon the Movement of Radiometer Vanes.** *Rend. Acc. Linc*, 5, 1, pp. 170-172. 1896. **16**
The writers attribute the retarding action of Röntgen rays to the electrostatic charge produced upon the walls of the tube containing the vanes.

**Frazer, Col. A. T.: Hindoo's Hand more Opaque to X-Rays than European's.** *Nature*, vol. 54, p. 483. **17**

**Freedman, W., on Shadow Pictures from Arc Light and Sunlight.** [S 7.]

**Frentzl, J., on Röntgen Rays.** [R 37.]

**Frost, E. B., on Experiments with X-Rays.** *Science*, vol. 3, p. 465. **18**
Results of experiments on reflection, the rectilinear propagation of the rays, &c., with an illustration of a case of apparent interference.

## G

**Galitzine, B., and A. de Karnojitzky on Properties of X-Rays.** [P 37].

**Galitzine, B., and A. de Karnojitzky on Röntgen Rays.** [R 38.]

**Garbasso, A., on Cathode Rays in an Electric or Magnetic Field.** [C 6.]

**Garbasso, A., on Röntgen Rays.** [R 39.]

**Gardiner, J. H.: Cathode and X-Rays, Distinction Between.** *Nature*, vol. 53, p. 486. **1**

**Gases, Electrification of by X-Rays.** [E 10.]

**Gases Exposed to Röntgen Rays.** E. Villari. *N. Cim.* 4, 4, pp. 234-240, 1896. **2**

The writer found that gases to which the power of dispersing electric charges had been imparted by Röntgen rays, by electric sparks or by the products of combustion in flames, have an increased thermal conductivity, which also points to the effect being due to a dissociation of molecules into free atoms which are more mobile. This property could not be imparted to ozone.

**Gauge, A New Vacuum.** [B 8.]

**Gauges, Two New Pressure, for Highest Vacua.** W. Sutherland. *Phil. Mag.*, vol. 43, p. 83. **3**

The author refers to the use of the tortion radiometer and to a disc viscosity meter. The article is not illustrated.

**Geissler Tubes, Phosphorescence and X-Rays in.** [P 8.]

**Gerard, M.: Propagation of X-Rays.** Roy. Acad. of Belgium. Also note in *Nature*, vol. 54, p. 204. **4**

The mode of propagation of X-rays through air. The author disagrees with Prof. Röntgen that air is less absorbent to X-rays than to cathode rays, and suggests that both possess the analogy of *not* travelling in perfectly straight lines.

**Geryk Air Pump.** [P 42.]

**Giazzi, F., on Röntgen Rays.** [R 40.]

**Gifford, J. W., on Failure of Tubes if the Platinum be above a certain Temperature.** *Nature*, vol. 54, p. 53. **5**

The author also mentions using fluorescing materials in connection with the photographic plate.

**Gifford, J. W., on Tube for Röntgen Rays.** [T 28.]

**Giltay, J. W., Action of X-Rays on Selenium.** [S 6.]

**Gladstone, Dr.: Action of Metals and their Salts on Ordinary Light, and on X-Rays.** B. A. Meeting, 1896. *Nature*, vol. 54, p. 583. **6**

**Godspeed, A. W., on Röntgen Phenomena.** [P 6.]

**Goldhammer, Dr., on the Nature of X-Rays.** *Weid. Ann.*, 57, pp. 636-638. 1896. **7**

The author inclines towards the belief that these rays are ultra-violet rays of exceedingly short wave length.

Goldstein, E., on Coloration of Salts by Cathode Rays. [C 12.]

Goldstein, E., on Röntgen Ray Photos. [P 12.]

Gossart, E., and H. Chevallier on Mechanical Action of X-Rays. [M 10.]

Gouy, M., on Occlusion in Crookes Tubes. [O 1.]

Gouy, M., on Refraction of Röntgen Rays. *C. R.*, 122, pp. 1,197-1,198. 1896. **8**

The author found no trace of refraction.

Gouy, M., on Refraction of Röntgen Rays. [R 19.]

Guggenheimer, M., on the Influence of Röntgen Rays on the Explosive Distance of the Electric Spark. *C. R.*, 124, p. 359. 1897. **9**

The writer found that the explosive distance increased when the micrometer balls were under the influence of Röntgen rays. The interposition of a fluorescing screen did not sensibly affect the result.

Guillaume, Ch., on Cathode Rays. [C 3.]

Guillaume, Ch., Recent Researches in Röntgen Rays. [R 105.]

Guillaume, Ch., on Röntgen Rays. [R 41, 42 and 43.]

Guillaume, Ch., on the X-Rays. *La Nat.*, No. 1,133, p. 129. **10**

## H

Halogens, Behaviour of, Relative to Röntgen Rays. *Bieblätter*, No. 1, p. 64. 1897. **1**

Hanchett, G. T., on Manipulation of X-Ray Apparatus. *Elec. World*, vol. 29, p. 377. **2**

Heart Disease and Röntgen Rays. [R 84.]

Heat Rays, Photography by means of. [P 18.]

Henry, C., on Röntgen Rays. [R 44 and 45.]

Henry, C., and H. Becquerel on Accumulation of Light. [A 4.]

Henry, C., on Luminous Excitation. [L 23.]

Henry, C., on Photography by Röntgen Rays, with Phosphorescent Zinc Sulphide. [P 24.]

Henry, C., and G. Seguy: Phosphoresence of Zinc Sulphide in Crookes Tube. [P 10.]

Heterogeneity of Crookes Tube Radiations. F. P. Le Roux. *C. R.*, 122, pp. 924-926. 1896. **3**

The writer proposes to call X-rays "hyperdiabatic" rays.

Heydweiller, A., on Röntgen Rays. [R 46.]

Hill, Dr., on Action of X-Rays on Pulmonic Affections. [R 103.]

Holtz, W., on Röntgen Rays. [R 47.]

Hospitalier, E., on Radiography. [R 7.]

Houston, E. J., and A. E. Kennelly on Edison's X-Ray Work. [E 2.]

Houston, E. J., and A. E. Kennelly on Alternating Currents and X-Rays. [A 10.]

Hurion, A., and M. Izarn on Röntgen Rays. [R 48.]

Hutchins, C. C., and F. C. Robinson on Crookes Tubes. [C 22.]

Hyper-Phosphorescence. S. P. Thompson. *Nature*, vol. 54, p 556. **4**

In which the author refers to the property which certain bodies have of emitting invisible rays after due stimulus. He also points out that calc-spar, apatite, rubies, sapphires, diamonds, uranium glass, scheelite, tourmaline, zinc, aluminium, magnesium and platinum, all emit X-rays in varying degrees of penetration when suitably stimulated. The work of Becquerel is cited and his results compared. (See also B 11 and 12.)

Hypothesis, Röntgen Ray. [R 95.]

## I

I'Anson, J.: Electrographs. [E 15.]

Images, Electric, in the Field of a Hittorf's Tube. N. Oumoff and A. Samoïloff. *Phil. Mag.*, vol. 42, p. 308. **1**

The authors deal with electrification images of various materials obtained upon sheets of ebonite when submitted to the radiation from a Hittorf's tube.

Imbert, A., and H. Bertin-Sans on Diffusion of Röntgen Rays. [D 11.]

Imbert, A., and H. Bertin-Sans on Radiography in Physiology. [R 6.]

Imparting Magnetic Deflection to X-Rays. A. Lafay. *C. R.*, 122, pp. 713-715. 1896. **2**

If the rays are passed through an electrified sheet of metal, a magnet is capable of producing deviation.

Instantaneous X-Ray Photos. Letter from Bonnella and Son. *Elec. Rev.* (Lond.), vol. 38, p. 374. [See also M 3.] **3**

**Intensity of X-Rays, Method of Estimating.** F. W. Branson. *Elec. Rev.* (Lond.), vol. 40, p. 251. **4**

The method consists of the use of an aluminium quadrant in millimetre steps, superposed on a sensitive plate and exposed for a definite time, the number of steps shown being proportional to the intensity of the X-rays.

**Interference, Case of Apparent.** [F 18.]

**Internal Rays.** [O 8.]

**Interrupter, Mercury.** [M 13.]

**Invisible Radiation, M. Becquerel's and G. Sagnac's Experiments in.** [R 1.]

**Invisibility of Röntgen Rays.** MM. Darien and De Roches. *C. R.*, 122, pp. 458-459. 1896. **5**

Experiments upon the opacity of various parts of the eye to X-rays.

**Invisible, Photographing the.** [P 15.]

**Invisible Rays (X-Rays).** P. Klementitch de Engelmeyer. *La Nat.*, No. 1,184, p. 157. [See also T 36, 37 and 38.] **6**

An account of experiments made by M. Puluj, and contains two illustrations, one of a normal hand and one of a hand with tuberculosis.

**Isenthal, A. W.: Summary of Work with the New Rays.** [S 31.]

## J

**Jackson, Mr., Interview with.** *Elec.*, vol. 38, p. 470. **1**

**Jaumann, G.: Longitudinal Light.** [L 20.]

**Jaumann, G.: Deflection (Electrostatic) of Cathode Rays.** [D 3.]

**Jaumann, G., and H. Poincaré, on Cathode Rays.** [C 4.]

**Johnson, V. E., on some Veterinary Applications of X-Rays.** [R 116.]

## K

**Kahlbaum's Automatic Air-pump.** O. Zoth. *Zeit. f. Instrumk.*, 16, pp. 65-77. 1896. **1**

**Kelvin, Lord, on Velocity of Propagation of Electrostatic Force.** *Nature*, No. 1,371, p. 316. **2**

Kelvin, Lord, and Drs. Beattie and de Smolan: Electrification of Air by Röntgen Rays. *Elec.*, vol. 38, p. 436. 3

Kelvin, Lord, and Drs. Beattie and de Smolan on Apparent and Real Diselectrification of Solids, produced by Röntgen Rays and by Flame. *Nature*, vol. 55, p. 473. 4

Kelvin, Lord, and Drs. Beattie and de Smolan on the Effect of Röntgen Rays on Paraffin in respect to Electric Conductance. [R 88.]

Kelvin, Lord, on the Generation of Longitudinal Waves in Ether. [W 3.]

Kelvin, Lord, and Drs. Beattie and de Smolan on Electrical Conductivity of Air Affected by Röntgen Rays and Ultra-Violet Light. *Nature*, vol. 55, p. 343, 1897. 5

An elaborate series of tests on the discharge of electrified bodies by Röntgen rays and ultra-violet light.

Ker, W., on Shadow Pictures by Arc Light Rays. [S 8.]

Kinematics of the Röntgen Rays. W. M. Stine. *Elec. Eng.* (N.Y.), vol. 21, p. 408, 1896. 6

The writer deals briefly with experiments on refraction, reflection, diffraction and interference of the rays, and favours the longitudinal theory.

König, W., on Röntgen Rays. [R 49.]

## L

Lafay, A.: An Imparted Magnetic Deflection to X-Rays. [I 2.]

Lafay, A., on Electrified Röntgen Rays. [E 11, 12 and 13.]

Lamp, A New Röntgen Ray. Siemens and Halske. *Elec. Rev.* (Lond.), vol. 40, p. 237. 1

This lamp is provided with a means of chemically varying the vacuum.

Lamp for X-Rays, New Form of. [W 5.]

Lamp, A Standard, for Röntgen Rays. [S 23.]

Lamps for Röntgen Rays. T. A. Edison. *Elec. Eng.* (N.Y.), vol. 21, p. 378. 1896. 2

Laryngeal Surgery and Röntgen Rays. Dr. Macintyre. *Brit. Med. Jour.*, vol. 1, p. 1,094. 1896. 3

An account of experiments on both living and dead subjects with special reference to the larynx.

Law of Opacity of Substances to Röntgen Rays. [O 5.]

Law of Photographic Action of Röntgen Rays. L. N. Vandevyver. *Jour. de Phys.*, 3rd series, vol. 61, p. 23. 1897. **4**

The following rule is given for time of exposure :—$t^1 = t\left(\frac{E^1}{E}\right)^3$, where $t$ = minimum time in minutes of exposure to obtain a sharp image of an object of thickness E and $t^1$ is the required time necessary in the case of an object of thickness $E^1$.

Lea, M. Carey, on Röntgen Rays not Present in Sunlight. *Am. Jnl. of Science*, vol. 51, p. 363, 1896, also *Elec.*, vol. 37, p. 75. [See also C 1.] **5**

Description of a number of experiments made to demonstrate that X-rays were not present in solar radiations. No X-rays were found to proceed from the light of a Welsbach lamp.

Lemoine, J., on Röntgen Rays in Paleontology. [R 99.]

Lenard, P., on Absorption of Cathode Rays. [A 1.]

Lenard, P.: Cathode Rays and X-Rays, a Comparison. Abs. in *Elec. Rev.* (Lond.), vol. 39, p. 722. **6**

Lenard, P., on Absorption of Cathode Rays. *Weid. Ann.*, vol. 56, p. 255; also *Elec. Rev.* (Lond.), vol. 38, pp. 97 and 131. **7**

Lenard Rays. *Elec.*, vol. 37, p. 676. A note. **8**

Lenard Rays and Röntgen Rays, Resemblance between. *Elec.*, vol. 36, p. 399. **9**

Leonard, C. Lester, on Physical Phenomena of X-Rays. *Elec. World*, vol. 28, p. 687. **10**

Light, Accumulation of. [A 4.]

Light, Dark. [D 1.]

Light and Electrification. [L 13.]

Light, Longitudinal. [L 20.]

Light, Longitudinal Component of. G. F. Fitzgerald. *Phil. Mag.*, vol. 42, p. 260. **11**

Light, Phosphorescent. [P 11.]

Light, Polarised, Electro-Optical Investigation of. [E 18.]

Light and Röntgen Rays, Action of on Electric Discharge. [M 14.]

Light Rays and Röntgen Rays, Absorption of by Crystallised Media. [A 2.]

Light, Ultra-Violet, and Electric Sparks. [U 1.]

Liquids and Solids, Opacity to X-Rays. [O 6.]

Liquids, Transparency of to X-Rays. [T 21.]

Living Tissue, Effect of X-Rays on. [X 7, and T. 19 and 20.]

Lodge, O.: Ferrotype Plates for X-Ray Work. *Elec.*, vol. 36, p. 865. **12**

Lodge, O., on Light and Electrification. *Science Prog.*, vol. 5, p. 423. 1896. **13**

The writer considers the new rays differ from ultra-violet light only in the matter of wave length, which he points out must be extremely short and comparable to the size of atoms.

Lodge, O., on the Present Hypothesis Concerning the Nature of Röntgen Rays. *Elec.*, vol. 36, p. 471. **14**

In which the author points out that all attempts so far made to show deflection of X-rays by a magnet have failed.

Lodge, O., on Progress in Radiography. *Elec.*, vol. 36, p. 783. **15**

A general summary of important work, together with some ingenious suggestions.

Lodge, O., on the Rays of Lenard and Röntgen. *Elec.*, vol. 36, p. 438. **16**

Lodge, O.: Röntgen Ray Experiments. *Elec.*, vol. 38, p. 169. [See also E 11, 12 and 13.] **17**

The writer describes experiments made with a Crookes tube containing three electrodes, two of which were cup shape. He was unable to repeat M. Lafay's results on deflection of X-rays magnetically, nor does he see how passing X-rays through a charged surface can electrify them. [See E 11.]

Lodge, O.: The Surviving Hypothesis Concerning X-Rays. *Elec*, vol. 37, p. 370. **18**

An application of various theories to show that X-rays are probably transverse etheric vibrations like light.

Lodge, O.: X-Rays with a Wimshurst Machine. [X 17.]

Londe, Albert, on a New Mercury Interrupter. [M 13.]

Longitudinal Component of Light. G. F. Fitzgerald. *Phil. Mag.*, vol. 42, p. 260. **19**

Longitudinal Light. G Jaumann. *Wied. Ann.*, No. 1, 1896, p. 147; Trans. *Elec.*, vol. 36, p. 417 and p. 685. **20**

Arguments in favour of the hypothesis that cathode rays are the result of longitudinal electric oscillations.

**Longitudinal Tension of Cathode Rays.** M. Colard. *C. R.*, vol. 123, p. 1,057. 1896. **21**

A mathematical article showing that a cathode ray in a magnetic field behaves like a perfectly flexible conductor carrying the same current, and that there is in that conductor a longitudinal tension which is constant throughout the whole path.

**Longitudinal Waves.** [B 23.]

**Lortet and Genoad, MM., on Röntgen Rays and Tuberculosis.** [T 37.]

**Lowering of Static and Dynamic Discharge Potentials by X-Rays.** R. Swyngedauw. *C. R.*, 122, pp. 374-376. 1896. **22**

**Lumière, A. and L.: Photographic Researches on Röntgen Rays.** [P 14.]

**Lumière, A. and L., on Photography through Opaque Bodies.** [P 20.]

**Luminous Excitation.** C. Henry. *C. R.*, 123, pp. 452-454. 1896. **23**

**Lussana, S., and M. Cinelli on Röntgen Rays.** [R 50.]

## M

**MacClelland, J. A., on Selective Absorption of Röntgen Rays.** *Proc. Roy. Soc.* (Lond.), vol. 60, p. 146. **1**

**Macfarlane, Alex.: Experiments with Röntgen Rays.** [R 93.]

**Macfarlane, Alex.: Source of X-Rays.** [S 16.]

**Macintyre, Dr.: Attempts to Polarise X-Rays.** *Proc. Roy. Soc.* (Edin.), vol. 21, p. 144. 1896. **2**

Negative results.

**Macintyre, Dr., on Applications of X-Rays to Soft Tissues of the Body.** [X 1.]

**Macintyre, Dr., on Röntgen Rays and Laryngeal Surgery.** [L 3.]

**Macintyre, Dr.: Instantaneous X-Ray Photos.** *Proc. Roy. Soc.* (Edin.), vol. 21, No. 2, p. 140. **3**

The writer found that a mercury interrupter enabled him to obtain more powerful fluorescence upon the walls of the tube, apparently, owing to the fact that a greater quantity of electricity was utilised in the discharge. X-ray photographs were obtained with only one flash of the mercury interrupter.

**Macintyre, Dr., on Some Results obtained with Röntgen Rays.** *Proc. Roy. Soc.* (Edin.), vol. 21, p. 137. **4**

**MacKissick, A. F., on Becquerel Rays.** [B 11.]

**Magnetic Deflection of Röntgen Rays.** [I 2.]

**Magnetic or Electrostatic Fields, Cathode Rays in.** [C 6.]

Magnetic Fields, Action of on Cathode Rays. [D 2.]

Magnetic Fields, Effects of Strong, on Electric Discharges in Vacuo. [S 37.]

Magnetic Field, Electric Discharge in. Sir D. SALOMONS. *Phil. Mag.*, vol. 42, p. 245. **5**

An article containing great detail of experiments on vacuum tubes of various special forms and placed in powerful magnetic fields. The author dwells upon the formation of bands of light in the tube produced by this means, and also notices the change of resistance of the gases within the tube. The ordinary spark in air is also briefly investigated.

Magnetic Field (Non-Uniform) and X-Ray Photography. [N 9.]

Magnetic Force acting on a Moving Electrified Sphere. ARTHUR SCHUSTER. *Phil. Mag.*, vol. 43, p. 1. **6**

Magnetic Forces, Effects of, on Cathode Rays. [C 10.]

Magnetism, Influence of, on the Nature of the Light Emitted by a Substance. [Z 1.]

Malagoli, R., and C. Bonacini on Reflection of Röntgen Rays. [R 15.]

Maltezos, C., on Röntgen Rays. [R 51, 52 and 115.]

Mance, H. O.: A Fluoroscope for Testing Efficiency of X-Ray Tubes. *Elec. Rev.* (Lond.), vol. 38, p. 760. **7**

Mance, H. O., Moore, H., and Phillips, C. E. S., on X-Rays. *Elec.*, vol. 36, p. 865. **8**

A letter announcing the observation of a ray to which bone is transparent. (See Editor's footnote.)

Marangoni on the Law of Opacity to Röntgen Rays. [O 5.]

Martinotti, C., on Röntgen Rays. [R 53.]

Maurain, C., on Röntgen Rays. [R 54.]

Mauritius, R., on Röntgen Rays. [R 55.]

Maximum Power of Crookes Tube. [C 23.]

Mayer, A., on Polarisation of Röntgen Rays. [P 30.]

Mayer, A., on Recent Work with Röntgen Rays. [R 107.]

Mechanical Action from Crookes Tube. J. R. RYDBERG. *C. R.*, 122, pp. 715-716. 1896. **9**

Mechanical Action of Röntgen Rays. E. GOSSART and H. CHEVALLIER. *C. R.*, 122, pp. 315-317. 1896. **10**

The movements of the vanes of a radiometer were stopped by exposure to X-rays.

Medal, Relief of a, Photographed with Röntgen Rays. [P 22.]

**Medical Applications of Röntgen Rays.** [R 98.]

**Medicine and Surgery, X-Rays in.** C. L. NORTON. *Science*, vol, 3, p. 730. **11**

Accounts of successful diagnosis and observations in practice.

**Medicinal Properties of X-Rays.** W. CAFFREY and N. S. WILSON. *Elec. World*, vol. 29, p. 67. **12**

**Mercury Interrupter for Induction Coil.** ALBERT LONDE. *La Nat.*, No. 1,236, p. 155. **13**

A layer of alcohol and water is used to cut off the spark above the surface of the mercury, and the inventor produces the oscillation of the beam carrying a dipping wire by means of a small motor.

**Merritt, E., on the Influence of Light upon the Discharge of Electrified Bodies.** *Science*, vol. 4, pp. 853-890. 1896. **14**

The writer deals with the principal workers in this field, including HERTZ, WEIDEMANN, RIGHI, &c., &c., summarises their results, and compares the action of ultra-violet light and Röntgen rays in discharging electrified bodies.

**Meslans, M., on Relation between the Chemical Nature of Bodies and their Opacity to Röntgen Rays.** [R 20.]

**Meslin, G., on Non-Uniform Magnetic Fields in X-Ray Photography.** [N 9.]

**Meslin, G., on Reduction of Exposure in Röntgen Photography.** [R 11.]

**Meslin, G., on a Röntgen Ray Photometer.** [R 100.]

**Metallic Vapours, Discharge Phenomena in Rarefied.** [D 14.]

**Metz, M., on Photographic Action of Cathode Rays.** *C. R.*, 122, pp. 880-881, 1896, and *Elec. Rev.* (Lond.), vol. 38, p. 658. [See also B 9.] **15**

**Michelson, A. A., and S. W. Stratton on the Source of X-Rays.** [S 18.]

**Michelson, A. A.: Theory of X-Rays.** [T 5.]

**Millor, D., on Röntgen Ray Experiments.** *Elec. World*, vol. 27, p. 309. **16**

**Minchin, G. M., on Charging Effects of X-Rays.** *Elec.*, vol. 36, p. 736. [See B 26 and R 23.] **17**

A letter in which he describes experiments which show that the charge which X-rays can give to an un-electrified body depends for its sign upon some quality in the body. He thus helps to explain an apparent discrepancy in the results of BORGMANN and RIGHI.

**Minck, F., on Röntgen Rays and Bacteria.** [B 3.]

Molecular Dissociation of Electricity by Röntgen Rays. J. Perrin. *C. R.*, 123, pp. 878-880. 1896. **18**

Moreau, G., on Röntgen Rays from Brush Discharge. [R 80.]

Mosetig, Prof.: Early Practical Results with X-Rays. [R 102.]

Müller, O., on Röntgen Rays. [R 56.]

Münsterberg, Hugo, on X-Rays. *Science*, vol. 3, p. 261. **19**
An article on Prof. Röntgen's discovery and the work leading to it.

Muras, T. H., on Röntgen Rays and their Source. [S 19.]

Murray, J. Erskine: Effect of X-Rays on the Contact Electricity of Metals. [R 87.]

## N

Nature of X-Rays. [G 7.]

Neesen, F., on Röntgen Rays. [R 57.]

Neuhauss on Röntgen Rays. *Zeit. f. Elek.-chem.*, pp. 462-463. 1896. **1**
Mention of the ordinary glow-lamp being used to produce X-rays.

New "Focus" Tube for X-Rays. [F 13.]

New Photography. Capt. Abney. *Photography*, vol. 8, p. 114. **2**
An inquiry as to the way in which a sensitive plate is acted upon, and a repudiation of true photographic action.

New Photography. Editorial Article (illustrated). *Elec. World*, vol. 27, p. 147. **3**

New Photography. Editorial Article. *Elec. World*, vol. 27, p. 171. **4**
Mentioning Pupin, records that interior electrodes are not necessary.

New Photography, The X-Rays and. [X 13.]

New Photography, The X-Rays and. Editorial Article. *Elec. Rev.* (Lond.), vol. 38, p. 332. **5**

New Radiation, The. Editorial Article. *Elec.*, vol. 36, p. 448. **6**

Niewenglowski, G. H., on Phosphorescent Light. [P 11.]

Nipher, F. E.: Rotation of Cathode Disc in Crookes Tube. *L'Eclair. Elec.*, 7, pp. 172-173, 1896; also *Elec.*, vol. 37, p. 350. **7**

**Nodon, S., on Röntgen Rays.** [R 58.]

**Nomenclature, Röntgen Ray.** *Elec. World*, vol. 27, p. 371. **8**
Many suggestions for a definite name for Röntgen phenomena by a number of American scientists.

**Non-Uniform Magnetic Field in X-Ray Photography.** G. Meslin. *C. R.*, 122, pp. 776-777. 1896. **9**

**Norton, C. L., and Lawrence, R. R., on Condenser Method of Producing X-Rays.** [C 15.]

**Norton, C. L., on Diagnosis of Disease by Means of X-Rays.** [D 19.]

**Norton, C. L., on X-Rays in Medicine and Surgery.** [M 11.]

**Novak, V., and O. Sulc on Absorptivity for Röntgen Rays.** [A 3.]

**Novak, V., and O. Sulc on Röntgen Rays.** [R 59.]

## O

**Occlusion in Crookes Tubes.** M. Gouy. *C. R.*, 122, pp. 775-776. 1896. **1**
That portion of a Crookes tube which has been exposed to intense cathode radiation becomes matt when heated, and when it is fused distinct bubbles become visible.

**Opacity of Bone to Röntgen Rays produced by Mineral Constituents.** J. Cormack and H. Ingle. *Nature*, vol. 53, p. 436. 1896. **2**

**Opacity to X-Rays, J. Dewar on.** [D 6.]

**Opacity to X-Rays.** O. Zoth. *Weid. Ann.*, No. 6, 1896, vol. 58, pp. 344-356; also *Nature*, vol. 54, p. 285. **3**
A table of results obtained under given conditions.

**Opacity to X-Rays greater in the case of Hindoo's Hand than in that of a European.** Col. A. T. Fraser, R.E. *Nature*, vol. 54, p. 483. **4**

**Opacity to Röntgen Rays, Law of.** Marangoni. *Atti de Lincei*, No. 11, p 403. 1896. **5**
The opacity of a substance to the rays is not proportional to its density, nor to its atomic weight. The writer concludes that probably the opacities are proportional to this latter when the layers of the substance are very thin.

**Opacity of Liquids and Solids to X-Rays.** MM. Bleunard and Labesse. *C. R.*, 122, pp. 723-725. [See also T 21.] **6**
Opacities of solutions varies with concentration. A saturated solution is quite opaque. Opacity increases with the atomic weight of a metal or non-metal contained in a compound.

**Opalescence and Diffusion with Röntgen Rays.** [D 10.]

**Opaque Bodies, Photography through.** LUMIÈRE. [P 20.]

**Opaque Bodies, Photography through.** D'ARSONVAL. [P 21.]

**Origin of X-Rays.** J. PERRIN. *C. R.*, 122, pp. 716-717. 1896. **7**
Finds X-rays are developed within the tube at any point on which the cathode rays impinge.

**Osterberg, Max: Röntgen Rays.** [R 60.]

**Oudin, P. and A. Barthélemy on a Crookes Tube for use with Alternating Currents.** [C 20.]

**Oudin, P., and Desire, K., on Internal Rays.** *Elec.*, vol. 38, p. 481. **8**

**Oumoff, N., and A. Samoïloff, on Electric Images in the Field of a Hittorf's Tube.** [I 1.]

**Owens, R. B., Effects of X-Rays on Tissues.** [T 20.]

## P

**Paleontology, Röntgen Rays in.** [R 99.]

**Peckham, W. C., on X-Ray Experiments.** *Elec. World*, vol 27, p. 633. **1**

**Peckham, W. C., on Röntgen Rays.** [R 61.]

**Penumbræ, Illusions of, and their Bearings on X-Ray Investigations.** G. SAGNAC. *C. R.*, Nov. 23, 1896; and *Elec.*, vol. 38, p. 448. **2**

**Permeability of Röntgen Rays.** W. ACKROYD and H. B. KNOWLES. *Proc. Phys. Soc.* (Lond.), vol. 14, p. 179. **3**
The authors found that substances of high molecular weight were more opaque to X-rays than those of low molecular weight.

**Perrin, J., on Discharge by Röntgen Rays—the Part Played by the Surfaces acted upon.** *C. R.*, 124, p. 455. 1897. **4**

**Perrin, J.: Function of the Dielectric in X-Ray Discharge Effects.** [D 15.]

**Perrin, J., on Molecular Dissociation of Electricity by Röntgen Rays.** [M 18.]

**Perrin, J., on the Origin of X-Rays.** [O 7.]

**Pfaundler, L., on Röntgen Rays.** [R 62.]

**Pflaum, H.: A Crookes Apparatus.** *Elec.*, vol. 36, p. 853. **5**
An account of curious changes observed to take place in the behaviour of a Crookes tube after long rests.

**Phenomena, Electric, of Röntgen Rays.** [E 9.]

**Phenomena, Electrical, Produced by X-Rays.** [R 23.]

**Phenomena, Röntgen.** A. W. Godspeed. *Science*, vol. 3, p. 395. **6**
Account of some early experiments in the laboratory of the University of Pennsylvania, and mentions the case of a sensitive plate exposed there on Feb. 22, 1890, to the discharge from a Crookes tube, showing in the resulting negative two black discs, the appearance of which was never satisfactorily explained till Röntgen's discovery gave the clue. An illustration from this plate is given.

**Phillips, C. E. S., Transparency of Coal Gas Flame to X-Rays.** *Elec.*, vol. 36, p. 559. **7**
Description of experiments to show that coal gas flame is transparent to X-rays. A poor source of rays was used.

**Phosphorescence and X-Rays in Geissler Tubes.** F. Campanile and E. Stromei. *Elec. Rev.* (Lond.), vol. 38, p. 718. **8**

**Phosphorescence and Röntgen Rays.** F. Campanile and E. Stromei. *N. Cim.*, 4-3, pp. 229-230. 1896. **9**
The writer describes a method of changing the conditions within a Crookes tube so as to produce the Crookes or Röntgen effects at will.

**Phosphorescence of Zinc Sulphide in Crookes Tube.** C. Henry and G. Seguy. *C. R.*, 122, pp. 1,198-1,199. 1896. **10**

**Phosphorescent Light.** G. H. Niewenglowski. *C. R.*, 122, pp. 385-386. 1896. **11**

**Phosphorescent Zinc Sulphide and Röntgen Ray Photography.** [P 24.]

**Photo-Electric Effect of Cathode Rays, Residual.** [R 22.]

**Photographs with Röntgen Rays.** E. Goldstein. *Berl. Ber.*, 30, pp. 667-672. 1896. **12**
Interesting to biologists and botanists, radiographs of shells, &c.

**Photographic Action of Cathode Rays.** Battelli. [B 9.]

**Photographic Action and Electric Discharge produced by Röntgen Rays.** Donati. [E 5.]

**Photographic Action of Röntgen Rays.** L. N. Vandevyver. *Jour. de Phys.*, 6, pp. 23-25. 1897. **13**
The writer found that the necessary exposure varied as the cube of the thickness of the object, and it also varies with the distance between the tube and the sensitive plate.

Photographic Films, Colson, R., on. [C 13.]

**Photographic Researches on Röntgen Rays.** A. and L. Lumière. *C. R.*, 122, pp. 382-383. 1896. **14**

The writers describe a number of experiments illustrating the fact that plates specially prepared for certain colours are of no advantage for use with X-rays.

**Photographing the Invisible.** Ch. de Villedeuil. *La Nat*, No. 1,217, p. 267. **15**

An account of a method of photographing the changes in the corona of the sun and also of experiments with X-rays.

Photography, Cathode. [C 2.]

**Photography within Crookes Tube.** H. Poincaré. *C. R.*, 122, p. 881. 1896. [See also M 15.] **16**

The writer suggests that the experiments of M. Metz upon this subject do not prove that cathode rays have the properties of Röntgen rays, for there may have been transformation of the cathode rays into Röntgen rays upon impact with the sensitive plate covering.

**Photography, Dark Light.** C. J. Reed. *Elec. World*, vol. 27, p. 119. **17**

**Photography by Heat Rays.** A suggestion. G. R. Courtenay. *Nature*, vol. 53, p. 579. **18**

**Photography, New Electro.** *Elec. Rev.* (Lond.), vol. 38, p. 97. **19**

An account of the first experiments with X-rays made by Mr. A. A. C. Swinton.

**Photography through Opaque Bodies.** A. and L. Lumière. *C. R.*, 122, pp. 463-465. 1896. **20**

**Photography through Opaque Bodies.** A. D'Arsonval. *C. R.*, 122, pp. 500-501. 1896. **21**

The writer discusses the difficulty of repeating Le Bon's results (see B 25), and points out some interesting modification which he has found it necessary to employ.

**Photography of Relief of Medals by Röntgen Rays.** J. Carpentier. *C. R.*, 122, pp. 526-527. 1896. **22**

**Photography, X-Ray.** MM. Brissaud and Londe. *La Nat.*, No. 1,214, p. 219. **23**

Account of successfully photographing a bullet in the brain.

**Photography by Röntgen Rays with Phosphorescent Zinc Sulphide.** C. Henry. *C. R.*, 122, pp. 312-314. 1896. **24**

Photography, Röntgen, Reduction of Exposure in. [R 11.]

**Photography with X-Rays.** E. ANDREOLI. *Elec. Rev.* (Lond.), vol. 38, p. 604. **25**

A practical account of simple of work.

**Photography in Vacuo.** Jos. COTTIER. *Elec. World*, vol. 27, p. 592. [See also B 9.] **26**

A rebuttal of evidence that sensitive plates lose their sensitiveness in vacuo, and against the idea of solarization during the short exposure necessary.

**Photometer for Röntgen Rays.** [R 100.]

**Photometry of X-Rays.** [R 26.]

**Physical Phenomena of X-Rays.** C. LESTER LEONARD. *Elec. World*, vol. 28, p. 687. **27**

Paper read before American Philosophical Society, Nov. 20, 1896.

**Physiology and Radiography.** [R 6.]

**Piltschikoff, N., on Emission of X-Rays.** [E 19.]

**Piltschikoff, N., on Röntgen Rays and an Electrostatic Condenser.** [R 91.]

**Plants, Germinating, Effect of X-Rays on.** H. WEBBER. *Elec. Rev.* (Lond.), vol. 29, p. 37; also *Science*, vol. 3, p. 919. **28**

The author does not find any heliotropic curvature of plants produced, but complains of inability to expose them to the X-rays for a longer period than 30 minutes, owing to heating of the tube. He refers to a Paper read before the German Botanical Society by A. SCHOBER.

**Poincaré, H., on Photographic Action within Crookes Tube.** [P 16.]

**Polarise X-Rays, Attempts to.** Dr. MACINTYRE. *Proc. Roy. Soc.* (Edin.), vol. 21, p. 144. **29**

With entirely negative results.

**Polarisation of Röntgen Rays.** A. MAYER. *Elec. World*, vol. 27, p. 508. [See also T 9.] **30**

The author finds them unpolarisable even with herapathite, by far the most powerful polariser known.

**Polarised Fluorescence.** L. SOHNCKE. *Weid. Ann.*, 58, pp. 417-454. 1896. **31**

**Ponderable Matter, Röntgen Rays Traversing.** [R 115.]

**Porter, T. C., Röntgen Ray Experiments.** *Nature*, vol. 54, p. 149. [See B 18; also *Nature*, vol. 54, p. 225.] **32**

The author describes some experiments in which he found that, when using an 18in. Wimshurst machine, X-rays were emitted or not, according as a brush discharge occurred on the wire leading to the anode. This led to varying the static conditions of the glass of the tube. The author placed a ring of copper wire round the tube, and in the plane of the cathode mirror's edge, but not touching the glass, and then caused very rapid discharges by having an earthed wire close to the ring. This greatly increased the fluorescence upon a suitable screen.

**Porter, T. C.: X-Rays with a Wimshurst Machine.** *Nature*, vol. 55, p. 30. [See also M 8.] **33**

The author employed a Wimshurst machine for X-ray work, and detected the presence of rays to which bone is transparent, also other rays to which wood is transparent but flesh opaque.

**Precious Stones, Action of X-Rays on.** A. Buget and A. Gascard. *C. R.*, 122, p. 726. 1896. **34**

Compounds of alumina and also pearls were found more transparent to the rays than were their imitations.

**Production of Silhouettes by Rontgen Rays.** C. V. Zenger. *C. R.*, 122, pp. 456-457. 1896. **35**

The writer expresses doubt as to the existence of X-rays.

**Properties of X-Rays.** H. Dufour. *C. R.*, 122, pp. 460-461. 1896. **36**

Descriptive of discharge effects.

**Properties of X-Rays.** B. Galitzine and A. de Karnojitzky. *C. R.*, 122, pp. 717-718. 1896. **37**

The writers found that two pieces of tourmaline were more opaque to X-rays when crossed and thus got evidence of polarisation.

**Properties, New, of X-Rays.** MM. Benoist and Hurmuzescu. *C.R.*, Feb. 3, 1896, p. 235. **38**

The writers found that X-rays discharged a charged electroscope, and more rapidly for negative than for positive charges.

**Pulmonic Affections and X-Rays.** [R 103.]

**Puluj, J., Account of Experiments by.** *La Nat.*, No. 1,184, p. 157. **39**

**Puluj, J., on Cathode Rays.** *Proc. Phys. Soc.* (Lond.), vol. 14, p. 178. **40**

The writer considers that the particles of matter torn from the cathode, which convey electrostatic charges by impact on the glass wall or on screens, equalise their charges, and in this process call forth a disturbance of the material molecules and also of their ether envelopes. Each portion bombarded by the cathode stream becomes the starting point of ether waves, which, according to their oscillation period and character, are either visible rays (phosphorescence) or invisible Röntgen rays. The oscillations of the invisible rays may take a longitudinal direction, but at present no convincing argument has been adduced to support this view.

**Puluj, J., on Röntgen Rays.** [R 63 and 64.]

**Pump, Air, Kahlbaum's.** [K 1.]

**Pump, Air.** [A 9, B 19, P 41.]

**Pump, The Berrenberg Mechanical Air.** [B 19.]

**Pump, Duplex Mercurial Air.** R. W. Wood. *Phil. Mag.*, vol. 41, p. 378. **41**

**Pump, The "Geryk" Air:** A Mechanical Pump. *Elec. Eng.* (Lond.), Feb. 1, 1895; also *Chemical Trades Journal*, April 14, 1894. **42**

**Pupin, M. J., on Diffusive Reflection of Röntgen Rays.** *Science*, vol. 3, p. 538. **43**

The writer arrived at the conclusion that regular reflection does not take place, but that there is an effect which he calls diffusive reflection.

**Pupin, M. J., on Röntgen Rays.** *Science*, vol. 3, p. 231. **44**

The writer draws a comparison between cathode and Röntgen rays, and gives an outline of the work of Crookes, Lenard, Hertz, &c., with details and illustrations of some results obtained by the writer with Röntgen rays.

## Q

**Quantitative Determination of Röntgen Rays.** J. J. Thomson. *Elec.*, vol. 36, p. 469. [T 15.] **1**

## R

**Radiations from Crookes Tube, Heterogenity of.** [H 3.]

**Radiation, Invisible.** Experiments by H. Becquerel and G. Sagnac. *Jour. de Phys.*, 5, pp. 193-202. 1896. **1**

M. Becquerel finds that the radiations from phosphorescent sulphide of zinc, calcium, or salts of uranium, differ in their properties from X-rays. The radiations, however, discharge charged conductors, but less promptly than Röntgen rays. Water and most metallic solutions are transparent to these rays. Metals are more transparent to the rays than to Röntgen rays, so also is quartz. The radiations are heterogeneous, they can be reflected, refracted and polarised, and are therefore probably light waves of small wave length.

**Radiation from Metallic Uranium.** [B 13.]

**Radiation, The New.** Editorial Article. *Elec.*, vol. 36, p. 448. **2**

**Radiation, The New.** [W 1.]

**Radiation, A New Form of.** [R 27.]

The *second paper* read by Prof. Röntgen before the Physico-Medical Society at Würzburg.

**Radiation, New Form of.** W. K. Röntgen. *Elec.*, vol. 36, p. 415. **3**

A translation of the full text of Prof. Röntgen's original paper read before the Würzburg Physico-Medical Society, in which he describes the experiments which led to his discovery of X-rays.

**Radiography.** F. H. VARLEY. *Brit. Jnl. of Phot.*, vol. 43, p. 232. **4**

A thoughtful series of suggestions for experiments to determine the cause of the photographic effects of Röntgen rays.

**Radiography, Notes on.** [E 3.]

**Radiography in Practice.** G. W. WEBSTER, *Brit. Jnl. of Phot. Almanac*, 1897, p. 641. [See also *Brit. Jnl. of Phot.*, vol. 43, p. 275 and 292.] **5**

An article giving simple practical instructions.

**Radiography in Physiology.** A. IMBERT and H. BERTIN-SANS. *C.R.*, 122, pp. 997-998. 1896. **6**

The writers have obtained photos through the shoulder, torsus, and the abdomen. They discuss the physiological value of such results.

**Radiography, Progress in.** [L 15.]

**Radiography.** E. HOSPITALIER. *La Nat.*, No. 1,184, p. 155. **7**

Description of suitable apparatus for repeating Prof. RÖNTGEN's results.

**Radiography, Stereoscopic.** [S 26.]

**Radiography.** G. W. WATSON. *Photography*, vol. 8, p. 708. **8**

Details of work done with a Wimshurst machine.

**Radiometer, Action of Röntgen Rays on.** [F 16.]

**Radiquet, M., on Fluorescence of Vitrified Materials under the Action of X-Rays.** [F 8.]

**Ranwez, F., on Röntgen Rays and Adulteration.** [A 8.]

**Raveau, C., on Röntgen Rays.** [R 65.]

**Rays, Becquerel.** [B 12.]

**Rays, Becquerel.** A. F. MCKISSICK. [B 11.]

**Rays of Lenard and Röntgen, O. Lodge on.** *Elec.*, vol. 36, p. 438. **9**

**Rays, Röntgen and Lenard, Resemblance between.** *Elec.*, vol. 36, p. 399. **10**

**Recent Work with Röntgen Rays.** [R 107.]

**Reducing Exposure in Röntgen Photographs.** G. MESLIN. *C. R.*, 122, p. 719. 1896. **11**

A magnet was employed to concentrate the cathode beam.

**Reducing Exposure in Röntgen Photography.** BASILEWSKI. *C. R.*, 122, p. 720. 1896. **12**

Use of fluorescent bodies in contact with the sensitive plate.

**Reed, C. J., Dark Light Photography.** *Elec. World*, vol. 27., p. 119. **13**

**Reflection of Cathode Rays.** [C 8.]

**Reflection of Röntgen Rays.** Lord BLYTHSWOOD. *Proc. Roy. Soc.* (Lond.), vol. 59, pp. 330-332. [See also *Nature*, vol. 54, p. 12.] **14**

**Reflection, Diffusive, of X-Rays.** [P 43.]

**Reflection of Rontgen Rays.** R. MALAGOLI and C. BONACINI. *Rend. Acc. Linc.*, 5, 1, pp. 327-331. 1896. **15**

**Reflection of Röntgen Rays.** [D 5.]

**Reflection of X-Rays.** O. ROOD. *Elec. World*, vol. 27, p. 508. **16**

Extract of paper read before Acad. Nat. Science, April 23, 1896, and is an account of experiments showing reflection to a certain extent.

**Reflection of X-Rays.** [F 18.]

**Refraction of Röntgen Rays.** F. BEAULARD. *C. R.*, 122, p. 782. 1896. **17**

Experiments in a vacuum with ebonite prism ; no definite results.

**Refraction of Röntgen Rays.** F. BEAULARD. *C. R.*, 123, pp. 301-302. 1896. **18**

Theoretical details.

**Refraction of Röntgen Rays.** [G 8.]

**Refraction of X-Rays.** M. GOUY. *C. R.*, 123, pp. 43-44. 1896. **19**

**Regulation of Röntgen Ray Tubes.** [T 30.]

**Reid, Dr.: Action of X-Rays on Skin Tissues.** [S 11.]

**Relation between the Chemical Nature of Bodies and their Opacity to X-Rays.** M. MESLANS. *C. R.*, 122, pp. 309-311. 1896. **20**

The writer found that the introduction of any mineral element into an organic molecule caused the body to become opaque to the rays.

**Remy, M., on Medical Application of Röntgen Rays.** [R 98.]

**Report of Röntgen Ray Work at British Association Meeting, 1896.** *Photography*, vol. 8, p. 622. [See also B 28.] **21**

**Repulsive Action of one Cathode Beam of Rays upon another.** [C 7.]

**Researches, Photographic, on Röntgen Rays.** [P 14.]

**Residual Photo-Electric Effect of Cathode Rays.** J. Elster and H. Geitel. *Weid. Ann.*, vol. 593, pp. 487-496, 1896; also *Elec.*, vol. 38, p. 183. 1896. **22**

The authors describe experiments made in order to test the photo-electric properties of various salts after their stimulation by X-rays. The apparatus was illustrated in *The Electrician* of above date. Very marked results were obtained.

**Resistance, Increase of, in Focus Tube.** [S 41.]

**Richarz, Franz: Action of Röntgen Rays on Steam.** [S 25.]

**Righi, A., on Electric Phenomena produced by X-Rays.** *Elec.*, vol. 36, p. 552. **23**

Description of experiments relating to the discharging of charged bodies by means of X-rays. He says: "The X-rays, unlike ultra-violet light rays, cause dispersion also from positively electrified bodies." He also observed that X-rays charge positively an unelectrified body. Original paper, *Proc.* of the R. Academia delle Scienze dell'Istituto di Bologna, 1896.

**Righi, A.: Experiments with Röntgen Rays.** A Note. *Phil. Mag.*, vol. 42, p. 530. **24**

**Righi, A.: Tubes for producing X-Rays.** *Elec.*, vol. 37, p. 675. **25**

**Righi, A., on Convection of Electricity produced by Röntgen Rays.** [C 18.]

**Righi, A., on Electric Charging by Röntgen Rays.** [R 89.]

**Righi, A., on Electrical Dispersion produced by Röntgen Rays.** [E 6.]

**Righi, A., on Electric Effects of X-Rays.** [E 7.]

**Righi, A., on Electric Phenomena of Röntgen Rays.** [E 9.]

**Righi, A., on Röntgen Rays.** [R 66.]

**Righi, A., on Transport of Electricity by Röntgen Rays.** [R 114.]

**Robinet, Jules, and Perret, Aug., on Electrography.** [E 16.]

**Róiti, A.: Photometry of X-Rays.** *Atti dei Lincei*, vol. 292, July, 1896; also *l'Electricista*, No. 9, 1896; *Elec.*, vol. 37, p. 670; and *Nature*, vol. 54, p. 111. **26**

Methods of comparing the intensity of X-ray sources. He points out that a spark between the coil and the anode increased the penetrative power of the rays (as to this see P 32.) He also obtained photos from a mercury anode. The rays appeared to proceed from the mercury surface.

**Róiti, A., on Cryptochroism.** [C 28.]

**Róiti, A., on Duration of Emission of X-Rays.** [R 86.]

**Róiti, A., on Point of Emission of Röntgen Rays.** [R 101.]

**Róiti, A., on Röntgen Rays.** [R 67, 68 and 69.]

**Röntgen, Wilhelm Konrad: Original Paper announcing his Discovery** (translation of). *Elec.*, vol. 36, p. 415. [R 8.]

**Röntgen, W. K., on a New Form of Radiation.** A Paper read before the Physico-Medical Society of Würzburg. Trans. in *Elec.*, vol. 36, p. 850. **27**

This is Prof. Röntgen's *second communication* upon the subject, and deals largely with the discharging and charging effects of the rays. He describes an experiment in which air that has had X-rays passed through it is shown to have the property of discharging a positively or negatively charged body brought into contact with it.

**Röntgen, W. K., Honours for.** *Elec. Rev.* (Lond.), vol. 38, p. 445; also p. 544. **28**

**Röntgen's Discovery.** J. Stokes. *Am. Ann. of Phot.*, 1897, p. 187. **29**

Brief outline of Prof. Röntgen's life and work and general remarks on his discovery.

**Röntgen Lamp, New (Siemens and Halske).** [L 1.]

**Röntgen Phenomena.** A. W. Godspeed. [P 6.]

**Röntgen Photography, Exposure in.** [E 21.]

**Röntgen Radiation, Experiments with.** R. Threlfall and J. A. Pollock. *Proc. Phys. Soc.* (Lond.), vol. 15, p. 1. **30**

The authors notice that the discharge between two electrodes of aluminium wire 1cm. apart, passed more easily in one direction than the other. This condition was found to depend upon a certain degree of vacuum, so that it could be used to detect very minute alterations in the rarefaction. X-rays were made to enter such a tube in order to ascertain whether any change of vacuum could be observed which would tend to support the charge particle theory of the X-rays. No such result was observed. The authors speak of the sensitivity of selenium to X-rays.

**Röntgen Rays.** A. Battelli. [B 9.]

**Röntgen Rays.** A. Battelli and A. Garbasso. [B 10.]

**Röntgen Rays.** V. Chabaud. *C. R.*, 122, pp. 237-238. 1896. **31**

The writer found that mercury 1mm. thick was opaque to the rays.

**Röntgen Rays.** J. T. Chabot. *l'Eclair. Elec.*, vol. 7, pp. 67-68. **32**

Experiments which showed that glass after exposure to X-rays is capable of effecting a photographic film.

Röntgen Rays. C. Doelter. *Chem. Zeit.*, Repertor, 20, 17, p. 183. 1896. **33**

The writer proposes a scale of transparency for minerals, thus : diamond (transparent) corundum, talc, quartz, rock-salt, calcspar, cerricite, vealgar (opaque).

Röntgen Rays. A. E. Dolbear. *Elec. World*, vol. 27, p. 147. **34**

The author wrote in April, 1894 : "It is actually possible to take a photograph of an object in absolute darkness with ether waves set up by working an electric machine." He considers the Röntgen effects a question of ether wave length only.

Röntgen's X-Rays. Editorial summary of work. *Elec. Rev.* (Lond.), vol. 38, p. 402. **35**

Röntgen Rays. G. Faè. *N. Cim.*, 4, 3, p. 191. 1896. **36**

The writer employed a magnet to concentrate the cathode rays and thus got a more powerful source of X-rays.

Röntgen Rays. J. Frentzl. *Chem. Zeit.*, 17, p. 151. 1896. **37**

Frentzl found no X-rays in the electric arc.

Röntgen Rays. B. Galitzine and A. de Karnojitzky. *Acad. Imp. des Sci.* (St. Petersburg), 3, No. 6, pp. 1-13. 1896. **38**

Investigations as to the source of the rays ; attempts to polarise the rays failed in the case of ordinary tourmaline, but with thin brown tourmaline a slight effect was obtained, showing evidence that the rays are transverse ether vibrations, and of the nature of light.

Röntgen Rays. A. Garbasso. *N. Cim.*, 4, 4, pp. 24-29. 1896. **39**

Somewhat weakens the arguments in favour of the ultra-violet light theory, and criticises the results of Sella and Majorana.

Röntgen Rays. F. Giazzi. *N. Cim.*, 4, 3, pp. 235-236. 1897. **40**

This article describes a way of preparing tungstate of calcium for making fluorescing screens.

Röntgen Rays. Ch. Guillaume. *C. R.*, 123, pp. 450-451. 1896. **41**

Some mathematical deductions on the assumption that the intensity of the Röntgen radiation is proportional to the intensity of the cathode rays which give rise to them.

Röntgen Rays. Ch. Guillaume. *La Nat.*, No. 1,211, p. 163. **42**

A general résumé of work.

Röntgen Rays. Ch. Guillaume. *La Nat.*, No. 1,202, p. 26. **43**

Illustrated account of best forms of tubes for X-rays, with account of experiments to show that in a focus tube the anti-cathode should be charged as positive as possible to get good X-ray emission. The article contains som interesting illustrations of shell-structure shown by X-rays.

**Röntgen Rays.** C. HENRY. *C. R.*, 122, pp. 787-790. 1896. **44**
Speculations as to the origin and relation of Röntgen rays to cathode rays.

**Röntgen Rays.** C. HENRY. *C. R.*, 123, pp. 450-451. 1896. **45**
Experiments with fluorescent bodies.

**Röntgen Rays.** A. HEYDWEILLER. *Chem. Zeit.*, 53, p. 521. 1896. **46**
Röntgen rays discharge electrically-charged bodies most actively when the angle of incidence is almost a grazing one, a property which is also shared by ultra-violet light.

**Röntgen Rays.** W. HOLTZ. *Wied. Ann.*, 57, pp. 462-463. 1896. **47**

**Röntgen Rays.** M. HURION and M. IZARN. *C. R.*, 122, pp. 1,195-1,197. 1896. **48**
Refraction experiments with aluminium prism.

**Röntgen Rays.** W. KÖNIG. *Ver. Phys. Ges.* (Berlin), 15, pp. 74-76. 1896. **49**
Details of apparatus.

**Röntgen Rays.** S. LUSSANA and M. CINELLI. *N. Cim.*, 4, 3, pp. 364-368. 1896. **50**
Confirms RIGHI's results as to the positive residual charge after exposure to X-rays.

**Röntgen Rays.** C. MALTÉZOS. *C. R.*, 122, pp. 1,474-1,476. 1896. **51**
Theoretical considerations as to X-rays being transverse ether vibrations, and if so what properties they may be expected to possess. The writer mentions BECQUEREL's radiations as being probably hyper-ultra violet transverse vibrations.

**Röntgen Rays.** C. MALTÉZOS. *C. R.*, 122, pp. 1,533-1,534. 1896. **52**
Assuming $\lambda = 0$ for X-rays, the law of propagation is the same as that for heat in a long bar, and the writer deduces that these radiations may be therefore of the nature of a particular magnetic flux.

**Röntgen Rays.** G. MARTINOTTI. *N. Cim.*, 4, 3, pp. 205-208. 1896. **53**
The writer professes to be able to obtain Röntgen effects by two hours' exposure to the flame of burning sulphur, or that of bisulphide of carbon burned in a spirit lamp.

**Röntgen Rays.** C. MAURAIN. *l'Eclair. Elec.*, 7, p. 549. 1896. **54**
Daguerreotype plates were not affected by Röntgen rays.

**Röntgen Rays.** R. MAURITIUS. *Weid. Ann.*, 59, pp. 340-349. 1896. **55**
Experiments with shadows cast by the X-rays.

**Röntgen Rays.** O. Müller. *Weid. Ann.*, 58, pp. 771-774. 1896. **56**

The rays seem to go round an opaque metallic object, carrying with them the shadow of a metal wire grating, if there be a sufficient reach of air in which they may spread.

**Röntgen Rays.** F. Neesen. *Ver. Phys. Ges.* (Berlin), 15, pp. 80-82. 1896. **57**

The writer describes an experimental tube from which the rays are made to pass out through a window of pig's bladder. The air pump had to be kept in continual action.

**Röntgen Rays.** Neuhauss. [N 1.]

**Röntgen Rays.** S. Nodon. *C. R.*, 122, p. 237. 1896. **58**

The writer finds that black paper protects a sensitive plate from the rays of an electric arc, but not from X-rays.

**Röntgen Rays.** V. Novák and O. Šulc. *Chem. Zeit.*, Repertor, 20, 17, p. 177. 1896. **59**

Experiments to show the opacity of various substances to X-rays. Precious stones can be tested by the rays.

**Röntgen Rays.** Max Osterberg. *Elec. World*, vol. 27, p. 382. **60**

Notes of a lecture in which it is stated that the vacuum of a Crookes tube is not increased with use if external electrodes only are used, and records experiments to show that *apparent* Röntgen effects obtained by sunlight are really due to filtration of light through the covering bodies.

**Röntgen Rays.** W. Peckham. *Elec. World*, vol. 27, p. 633' 1896. **61**

Fluorescent effects and general discussion as to the electrical condition of the tube.

**Röntgen Rays.** L. Pfaundler. *Wien. Ber.*, 105, 1, part 2, pp. 112-116. 1896. **62**

Practical hints.

**Röntgen Rays.** J. Puluj. *Wien. Ber.*, 105, 2-4, part 2a, pp. 228-238. 1896. **63**

Experiments as the origin of the rays.

**Röntgen Rays.** J. Puluj. *Wien. Ber.*, 105, 2-4, part 2a, pp. 243-245. 1896. **64**

Röntgen rays from a mica anti-cathode.

**Röntgen Rays.** M. J. Pupin. [P 44.]

**Röntgen Rays.** C. Raveau. *l'Eclair. Elec.*, 6, pp. 249-250. 1896.

Theoretical discussion as to their nature. **65**

**Röntgen Rays.** A. Righi. *C. R.*, 123, pp. 399-400. 1896. **66**

Röntgen Rays. A. Róiti. *Rend. Acc. Linc.*, 5, 1, pp. 156-162. 1896. **67**

Röntgen Rays. A. Róiti. *N. Cim.*, 4, 4, pp. 173-180. 1896. **68**
Experiments with particular forms of tubes are described. Cathode rays produce X-rays when they strike liquids, not when they encounter gases. They decompose sulphuric acid forming $SO_2$ and oxygen.

Röntgen Rays. A. Róiti. *N. Cim.*, 4, 4, pp. 232-234. 1896. **69**
Experiments with the cryptochrose, analagous to photometrical measurements of light, according to the three-colour method. The writer came to the conclusion that Röntgen rays are not of a homogeneous character even when they have the same source, and that many rays having different penetrative powers are always present.

Röntgen Rays. E. Salvioni. [S 2.]

Röntgen Rays. A. Sandrucci. *N. Cim.*, 4, 3, pp. 353-359. 1896. **70**
The writer discusses whether X-rays produce photographic effects upon the sensitive film directly, or through the medium of the fluorescence of the glass plate.

Röntgen Rays. A. Schuster. [S 5.]

Röntgen Rays. Sir G. Stokes. [S 28 and 29.]

Röntgen Rays, The, J. J. Thomson on. *Nature*, vol. 54, p. 302. **71**
Report of the "Rede" Lecture at Cambridge University.

Röntgen Rays. J. J. Thomson. [T 16.]

Röntgen Rays. G. Vicentini and G. Pacher. [V 2.]

Röntgen Rays. E. Villari. *C. R.*, 123, pp. 418-421. 1896. **72**

Röntgen Rays. E. Villari. *C. R.*, 123, pp. 446-449. 1896. **73**

Röntgen Rays. E. Villari. *Rend. Acc. Sci. Fis. e Mat.* (Naples), Feb. 15, 1896. **74**
The writer employed a thermopile to detect any heating effect from the Crookes tube. It was also found that Röntgen rays can be reflected from zinc, but not from glass, vulcanite, or aluminium.

Röntgen Rays. E. Villari. *C. R.*, 123, pp. 107-109. 1896. **75**
Discharge experiments.

Röntgen Rays. E. Villari. *Rend. Acc. Linc.*, 5, 2, p. 93. 1896. **76**
Air which has been excited by X-rays possessed the property of discharging electrified bodies.

Röntgen Rays. E. Villari. [V 4.]

Röntgen Rays. A. Winkelmann and R. Straubel. *Jenaisch Zeit. f. Nat.*, vol. 30, 1896. **77**

If Röntgen rays traverse glass, then a sensitive film, and ultimately fall upon fluorspar, the film is affected say 100 times as rapidly where the fluorspar is than elsewhere.

Röntgen Rays, Absorptivity for. [A3.]

Röntgen Rays, Action of, on Bacteria. [B 2.]

Röntgen Rays, Action of, on Electric Spark. [E 8.]

Röntgen Rays, Action of, on Radiometer. [F 16.]

Röntgen Rays, Action of, on Skin Tissues. [S 11 and 12.]

Röntgen Rays, Action of, on Steam. [S 25.]

Röntgen Rays and Adulteration. [A 8.]

Röntgen Ray Apparatus. *Elec. Rev.*, vol. 39, p. 678. 1896. **78**

An account of various methods of constructing X-ray tubes, with special reference to photographing interior structures of the body (esographs).

Röntgen Rays, Apparatus for Producing. [A 15.]

Röntgen Rays: Are they Polarised? J. W. Gifford. *Nature*, vol. 54, p. 172. 1896. **79**

Röntgen Rays and Bacteria. [B 3.]

Röntgen Rays and Becquerel Rays Provoke Thermo-Luminescence. [B 27.]

Röntgen Rays from Brush Discharge. G. Moreau. *C. R.*, 122, pp. 228 239. 1896. **80**

Experiments of the nature of those made by Lord Blythswood (see B 22), only with an induction coil. The writer was not successful in repeating his results with a Wimshurst machine.

Röntgen Rays and Cathode Rays. W. Arnold. [C 9.]

Röntgen Rays and Consumption. [C 16.]

Röntgen Rays and Consumption. L. Bouchard. [C 17.]

Röntgen Rays, Convection of Electricity Produced by. [C 18.]

Röntgen Rays and Dermatitis. [D 4.]

Röntgen Rays Destroy Tuberculosis. [T 36.]

Röntgen Rays, Diffraction of. Bungetziano. *l'Eclair. Elec.*, 7, pp. 165-167. 1896. **81**

Indefinite results.

**Röntgen Rays, Diffraction of.** L. Calmette and G. T. Lhuillier. [D 9.]

**Röntgen Rays, Diffusive Reflection of.** [P 43.]

**Röntgen Rays, Diffusion of.** A. Imbert and H. Bertin-Sans. [D 11.]

**Röntgen Rays, Discharge by.** E. Villari. *N. Cim.*, 4, 4, p. 170-173. 1896. **82**

The writer found that the order in which the following vapours or gases most readily permit discharge is: hydrogen, coal gas, air, carbon anhydride, ether vapour and bisulphide of carbon vapour.

**Röntgen Rays, Discharge by.** E. Villari. [D 17.]

**Röntgen Rays, Discharge by, in Solid, Liquid and Gaseous Media.** E. Villari. *Rend. Acc. Sci. Fis. e Mat.* (Naples), 2, 6 and 7, p. 214. 1896. **83**

**Röntgen Rays, Discharge of, by Electric Sparks.** E. Villari. [D 18.]

**Röntgen Rays, Discharge by Means of.** [D 16.]

**Röntgen Rays and Disease of the Heart.** *Elec. Rev.* (N.Y.), Dec. 30, 1896. **84**

A brief description with illustration of the appearance of the heart and its actions as seen by the aid of Röntgen rays.

**Röntgen Rays and Dry Plates.** J. M. Eder and E. Valenta. *Photo. Corr.*, 33, p. 218. 1896. **85**

No advantage to use orthochromatic plates. Heating the film to 50°C. shortened the exposure.

**Röntgen Rays, Duration of Emission of.** A. Róiti. *Rend. Acc. Linc.*, 5, 1, pp. 243-245. 1896. **86**

**Röntgen Rays, Effect of, on Contact Electricity of Metals.** J. Erskine Murray. *Proc. Roy. Soc.* (Lond.), vol. 59, p. 333. **87**

The author found that the contact potential was not changed, but that the air between the surfaces of the plates was converted into an electrolyte which formed a connection between the plates, and so reduced the potential.

**Röntgen Rays, Effects of, on Germinating Plants.** [P 28.]

**Röntgen Rays, Effect of, on Higher Animals.** [A 12.]

**Röntgen Rays, Effect of, on Electric Discharge and Photographic Action.** [E 5.]

**Röntgen Rays, Effects on Electrified Bodies.** [B 16.]

**Röntgen Rays, Effect of, on Paraffin in Respect of Electric Conductance.** Lord KELVIN, Drs. BEATTIE and DE SMOLAN. *Elec.*, vol. 38, p. 401. **88**

A series of tests showing that paraffin is not made conductive when acted upon by Röntgen rays.

**Röntgen Rays and Electric Charges.** [E 4.]

**Röntgen Rays, Electric Charging by.** A. RIGHI. *C. R.*, 122, pp. 878-880. 1896. **89**

**Röntgen Rays, Electric Phenomena of.** [E 9.]

**Röntgen Rays, Electrical Discharge by Means of.** J. J. THOMSON. [T 12.]

**Röntgen Rays, Electrical Dispersion Produced by.** A. RIGHI. [E 6.]

**Röntgen Rays.** *Elec. Rev.* (Lond.), vol. 38, p. 591. **90**

Description of the tubes used by Prof. S. P. THOMPSON, with an account of the stages of exhaustion of them and the accompanying phenomena. Also observations by Mr. ACKROYD and Mr. H. B. KNOWLES on the effect of colour on the passage of X-rays.

**Röntgen Rays, Electrification of Air by.** [K 3.]

**Röntgen Rays, Electrified.** A. LAFAY. [E 11, 12 and 13.]

**Röntgen Rays, Electro-Chemical Action of.** [E 14.]

**Röntgen Rays and an Electrostatic Condenser.** N. PILTSCHIKOFF *C. R.*, 122, p. 839-840. 1896. **91**

In a thin electrostatic field, between charged paraffin and a zinc plate put to earth, Röntgen rays have no discharging effect.

**Röntgen Rays, Emission of, by a Tube containing Fluorescing Matter.** [E 19.]

**Röntgen Rays, Energy of.** J. TROWBRIDGE. [T 26.]

**Röntgen's Epoch-Making Discovery.** L. BOLTZMANN. *Zeit. f. Elek.-chem.*, Jan. 15, 1896. **92**

**Röntgen Ray Experiments.** O. LODGE. [L 17.]

**Röntgen Rays, Experiments on.** T. C. PORTER. [P 32.]

**Röntgen Rays, Experiments with.** S. P. THOMPSON. [T 9.]

**Röntgen Rays, Experiments with.** Alex. Macfarlane. *Elec. World*, vol. 27, p. 281. **93**

An attempt to prove from which part of the tube the Röntgen rays radiate (illustrated.)

**Röntgen Ray Experiments.** D. C. Millor. *Elec. World*, vol. 27, p. 309. **94**

**Röntgen Rays, Fluorescence of Vitrified Materials under Action of.** [F 8.]

**Röntgen Rays, Gases Exposed to.** [G 2.]

**Röntgen Rays Hypothesis.** *Elec. Rev.* (Lond.), vol. 39, p. 353. **95**

Editorial article on the transverse vibration theory.

**Röntgen Rays, Influence of, on the Explosive Distance of the Electric Spark.** [G 9.]

**Röntgen Rays, Invisibility of.** [I 5.]

**Röntgen Ray Kinematics.** [K 6.]

**Röntgen Rays, a Proposed Standard Lamp for.** [S 23.]

**Röntgen Rays and Laryngeal Surgery.** [L 3.]

**Röntgen Rays, Law of Opacity of Substances to.** [O 5.]

**Röntgen Rays and Lenard Rays, Resemblance Between.** *Elec.*, vol. 36, p. 399. 1896. **96**

**Röntgen Rays and Light Rays, Absorption of, by Crystallised Media.** [A 2.]

**Röntgen Rays at Low Temperatures.** L. Bleekrode. *Elec. Rev.* (Lond.), vol. 38, p. 756. **97**

The author obtained no marked effects by lowering the temperature of the X-ray tube to - 79°.

**Röntgen Rays, Mechanical Action of.** [M 10.]

**Röntgen Rays, Medical Applications of.** M. Remy. *La Nat.*, No. 1,227, p. 12. **98**

A short article containing a beautiful illustration of an X-ray photo of a hand and arm.

**Röntgen Rays, Molecular Dissociation of Electricity by.** [M 18.]

**Röntgen Rays in Paleontology.** J. Lemoine. *C. R.*, 123, pp. 764-765. 1896. **99**

Some points in classification, depending upon the solidity or otherwise of the vertibræ of fishes have been cleared up by means of X-rays.

**Röntgen Rays, Permeability of.** [P 3.]

**Röntgen Rays and Phosphorescence.** [P 9.]

**Röntgen Ray Photographs.** [P 12.]

**Röntgen Rays, Photographic Researches on.** [P 14.]

**Röntgen Rays, Photographic Action of.** [P 13.]

**Röntgen Rays, Photography of Arterial System by.** [A 17.]

**Röntgen Ray Photometer, A.** G. MESLIN. *Jour. de Phys.*, 5, pp. 202-204. 1896. **100**

The article deals with the construction of an instrument for measuring the relative brightness of fluorescent materials.

**Röntgen Rays, Point of Emission of.** A. RÓITI. *Rend. Acc. Linc.*, 5, 1, pp. 185-188. 1896. **101**

**Röntgen Rays, Polarisation of.** [P 30.]

**Röntgen Rays, Practical Application of.** MOSETIG. *Elec.*, vol. 36, p. 402. **102**

Injuries caused by a revolver shot in the hand, and the position of the shot located; malformation of a foot shown by X-rays, &c. Prof. S. P. THOMPSON has found X-rays in the light of an electric arc and has obtained a "radiograph" by this means.

**Röntgen Rays, Production of Silhouettes by.** [P 35.]

**Röntgen Rays and Pulmonic Affections.** Dr. HILL. *La Nat.*, No. 1,238, p. 179. **103**

An account of apparently peculiar curative action of the X-rays and effect upon microbes. Later work has shown the action to have been probably accidental.

**Röntgen Rays, Recent Researches in.** A summary. *Nature*, vol. 54, p. 109. **104**

Including accounts of attempts to polarise the rays, action on selenium, nature of X-rays, plant structure revealed by X-rays, and photometer for X-rays.

**Röntgen Rays, Recent Researches in.** CH. GUILLAUME. *La Nat.*, No. 1,195, p. 327. **105**

**Röntgen Rays, Recent Researches in.** *Elec. Rev.* (Lond.), vol. 38, p. 562. **106**

**Röntgen Rays, Recent Work with.** A. M. MAYER. *Nature*, vol. 53, p. 522. **107**

An important summary, dealing also with reflection experiments (illustrated).

**Röntgen Rays, Reflection of.** DERY-DEVELSHAUVERS. [D 5.]

**Röntgen Rays, Refraction of.** M. GOUY. [G 8 and R 19.]

**Röntgen Rays, Reflection of.** Lord BLYTHSWOOD. [R 14.]

**Röntgen Rays, Reflection of.** R. Malagoli and C. Bonacini. [R 15.]

**Röntgen Rays, Refraction of.** F. Beaulard. [R 17 and 18.]

**Röntgen Rays, Selective Absorption of.** J. A. McClelland. *Proc. Roy. Soc.* (Lond.), vol. 60, p. 146. **108**

Experiments on above with tables of results.

**Röntgen Ray Shadows, Distinctness of.** [S 9.]

**Röntgen Rays, Some Results obtained with.** J. Macintyre. *Proc. Roy. Soc.* (Edin.), vol. 21, p. 137. **109**

**Röntgen Rays, Source of.** A. Battelli. [S 14.]

**Röntgen Rays, Source of.** W. M. Stine. [S 27.]

**Röntgen Rays, Source of.** Stcherbakof. [S 22.]

**Röntgen Rays.** Summary of work to date (August, 1896). *Nature*, vol. 54, p. 354. **110**

**Röntgen Rays.** Summary of work. *Elec. Rev.* (Lond.), vol. 38, pp. 437, 506, 532, 562. **111**

**Röntgen Rays.** Summary. *Elec. Rev.* (Lond.), vol. 38, p. 658. **112**

In which mention is made of M. Lafay's experiments showing the deflectibility of X-rays by means of a magnet, and also the work of M. Metz in which he showed that cathode rays within the discharge tube affect a sensitive plate (see B 9.)

**Röntgen Rays.** Summary of work to June, 1896. *Nature*, vol. 54, p. 302. **113**

The Rede Lecture given at Cambridge University on June 10 by Prof. J. J. Thomson, F.R.S.

**Röntgen Rays in Sunlight.** [S 35.]

**Röntgen Rays and Sunlight.** [S 34.]

**Röntgen Rays, A Theory of.** [W 4.]

**Röntgen Rays, Transparency of Gases to.** [B 15.]

**Röntgen Rays, Transparency of Liquids to.** [T 21.]

**Röntgen Rays, Transparency to.** [T 22.]

**Röntgen Rays and Transport of Electricity.** A. Righi. *N. Cim.*, 4, 4, pp. 167-169. 1896. **114**

In the dispersion of electric charges under Röntgen rays, the material particles pursue trajectories, generally curved, which coincide sensibly with the lines of force. The points where they fall upon an ebonite plate are disclosed by sprinkling over it a mixture of sulphur and minium. The phenomena are similar to that of electric convective discharge through a gas.

**Röntgen Rays Traversing Ponderable Matter.** C. Maltézos. *C. R.*, 122, pp. 1,115-1,117. 1896. **115**

The writer developes mathematical reasons why the absorption of Röntgen rays by various substances should vary with the density.

**Röntgen Rays, Tube for.** Szymánski. [T 29.]

**Röntgen Rays, Tubes Productive of.** A. Righi. [T 34.]

**Röntgen Rays, Tubes for.** H. Boas. [T 31.]

**Röntgen Rays and Ultra-Violet Light, Action of, on Explosive Discharge in Air.** [E 20.]

**Röntgen Rays, Velocity of.** [V 1.]

**Röntgen Rays, Veterinary Applications of.** V. E. Johnson. *Photography*, vol. 8, p. 610. **116**

An account of a case where X-rays detected a wrong diagnosis.

**Röntgen Rays, Visibility of.** [V 5.]

**Röntgen Rays, A Vortex Theory of.** A. A. Michelson. *Elec. World*, vol. 27, p. 390. **117**

**Rontgen Rays, Wave Length of.** [F 15.]

**Röntgen Ray Work, Notes on.** Willyoung and Sayen. *Elec. Rev.* (Lond.), vol. 40, p. 373. **118**

The article refers to the time required to obtain X-ray photos of the trunk, and to the inflammatory action of X-rays upon the skin. [See also S 12.]

**Röntgen Tubes.** H. Armagnat. *l'Ind. El.*, 5, pp. 117-118. 1896. **119**

Indefinite experiments with various forms of tubes and combinations of coils.

**Rood, O., on Reflection of X-Rays.** [R 16.]

**Rotation of Cathode Disc in Crookes Tube.** [N 7.]

**Roux on Heterogeneity of Radiations from Crookes Tube.** [H 3.]

**Rowland, H. A., on Wave Length of X-Rays.** [W 2.]

**Rowland, H. A., J. Briggs, and R. Carmichael, on Source of X-Rays.** [S 20.]

**Rowland, Sidney: Report on the Applications of the New Photography to Medicine and Surgery.** *Brit. Med. Jour.*, vol. 1, pp. 361, 481 and 492. 1896. **120**

**Rutherford, E.: Electrification of Gases Exposed to Röntgen Rays, and the Absorption of X-Rays by Gases and Vapours.** [E 10.]

**Rydberg, J. R., on Mechanical Action from Crookes Tube.** [M 9.]

## S

**Sagnac, G., on Becquerel's Experiments on Invisible Radiations.** [R 1.]

**Sagnac, G., on Penumbræ Illusions and their Bearing on X-Ray Investigations.** [P 2.]

**Salomons, Sir D.: Electric Discharge in a Magnetic Field.** [M 5.]

**Salts, Colouration of, by Cathode Rays.** [C 12.]

**Salvioni, E.: Production of Shadows by Röntgen Rays.** *Elec. Rev.* (Lond.), vol. 38, p. 550. 1896. **1**

Translation of a paper read before the Medico-Surgical Academy of Perugia, Feb. 22, 1896. An account of experiments with fluorescing materials.

**Salvioni, E., on Röntgen Rays.** *Atti Accad. Med.-Chirurg* (Perugia), vol. 8, Nos. 1 and 2. 1896. **2**

Theoretical discussion as to the nature of Röntgen rays.

**Salvioni, E., on Distinctness of Röntgen Ray Shadows.** [S 9.]

**Sandrucci, A., on Fluorescence of Glass in X-Ray Photography.** *N. Cim.*, vol. 3, p. 353; also *Elec. Rev.* (Lond.), vol. 39, p. 551. **3**

The experiments go to show that the sensitive film of the photographic plate is itself acted upon directly by X-rays.

**Sandrucci, A., on Röntgen Rays.** [R 70.]

**Schmidt, G. C., on Fluorescence.** [F 4.]

**Schuster, A.: Magnetic Force Acting on a Moving Electrified Sphere.** *Phil. Mag.*, vol. 43, p. 1. **4**

**Schuster, A., on Röntgen Rays.** *Brit. Med. Jour.*, vol. 1, p. 172. 1896. **5**

A brief and clear account of Prof. RÖNTGEN's discovery.

**Screen, A New Fluorescent.** [F 9.]

**Screens, Fluorescent (Tungstate of Calcium).** [R 40.]

**Segalin, L., on Crookes Tubes.** [C 24.]

**Selenium, Effect of X-Rays on.** J. W. GILTAY. *Nature*, vol. 54, p. 109. **6**

The author points out that a selenium cell slowly recovers from stimulation by X-rays.

**Sella, A., and Q. Majorana on the Action of Röntgen Rays on the Electric Spark.** [E 8.]

**Sella, A., and Q. Majorana on Effect of X-Rays and Ultra-Violet Light on Electric Sparks.** [E 8.]

**Sella, A., and Q. Majorana on Effect of Ultra-Violet Light and Röntgen Rays upon Explosive Discharge in Air.** [E 20.]

**Sella, A., and Q. Majorana on Velocity of Röntgen Rays.** [V 1.]

**Semmola, E., on Crookes Tubes.** [C 25.]

**Sestini, Q., on Crookes Tubes.** [C 26.]

**Shadow Pictures from Arc and Sunlight.** W. Freedman. *Elec. Eng.* (N. Y.), vol. 21, p. 256. 1896. **7**

**Shadow Pictures by Arc Light Rays.** W. Ker. *Elec. Eng.* (N. Y.), vol. 21, p. 309. 1896. **8**

**Shadow Radiograph.** [R 7.]

**Shadows by Röntgen Rays, Distinctness of.** E. Salvioni. *Atti Accad. Med.-Chirurg* (Perugia), Nos. 1 and 2. 1896. **9**

**Shortening Exposure to Röntgen Rays.** A. Battelli and A. Garbasso. *N. Cim.*, 4, 3, pp. 167-168. 1896. **10**

Suggests the use of fluorescing materials in contact with the back of the sensitive plate.

**Shrader, Dr., on Action of Röntgen Rays on Bacteria.** [B 2.]

**Siemens' and Halske's New Röntgen Lamp.** [L 1.]

**Silhouettes, Production of, by Röntgen Rays.** [P 35.]

**Skin, Action of Röntgen Rays on.** E. W. Reid. *Photography*, vol. 9, p. 108. **11**

The author records the action on his own stomach and chest of prolonged exposure to the rays.

**Skin Affected by X-Rays.** *Elec. Rev.* (Lond.), vol. 40, p. 538. **12**

A means is suggested for preventing this action by the interposition of an aluminium screen to prevent the electric discharge reaching the patient. (See also *Elcc. Rev.* (Lond.), vol. 40, p. 373).

**Skin Pictures by Röntgen Rays.** Dr. Walsh. *Brit. Med. Jour.*, vol. 1, p. 797. 1896. **13**

**Sohncke, L., on Polarised Fluorescence.** [P 31.]

**Solids and Liquids, Opacity of, to X-Rays.** [O 6.]

**Source of Röntgen Rays.** W. M. Stine. [S 27.]

**Source of Röntgen Rays.** A. Battelli. *N. Cim.*, 4, 3, pp. 129-141. 1896. **14**

The Röntgen rays originate at the surface first struck by the cathode rays.

**Source of X-Rays.** C. L. CORY, J. LE CONTE and R. W. LOWMAN. *Elec. World*, vol. 27, p. 424. **15**

An exhaustive series of experiments was tried, leading to the conclusion that the source is the first solid upon which the cathode rays strike.

**Source of X-Rays.** ALEX. MCFARLANE. *Elec. World*, vol. 27, p. 548. **16**

An attempt to controvert the cathodic theory. (Illustrated).

**Source of X-Rays.** D. W. HERRING. *Elec. World*, vol. 27, p. 395. **17**

The author criticises E. THOMSON'S and ROWLAND'S conclusions as to the "anodic" source

**Source of X-Rays.** A. A. MICHELSON and S. W. STRATTON. *Science*, vol. 3, p. 695. **18**

The writers give details of a series of experiments to show that the source of the rays is the surface first encountered by the cathode rays. (May 8, 1896.)

**Source of X-Rays.** T. H. MURAS. *Elec. Rev.* (Lond.), vol. 38, p. 240. 1896. **19**

Experiments were carried out with a Crookes tube with three electrodes, the centre one of which was idle, and served merely to reflect the cathode beams. Pinhole photos showed that the X-rays seemed to originate at the surface of this idle electrode. (The article is fully illustrated.)

**Source of X-Rays.** H. A. ROWLAND, J. BRIGGS and R. CARMICHAEL. *Am. Jnl. of Science*, vol. 1, 4th series, p. 247. **20**

**Source of X-Rays.** C. S. SCRIBNER and F. R. MCBERTY. *Elec. World*, vol. 27, p. 394. **21**

A series of experiments showing apparently the inner wall of the tube to be the source. (The article is illustrated).

**Source of X-Rays.** STCHERBAKOF. *C. R.*, 122, p. 1,155. 1896. **22**

The writer thinks the rays originate within the tube.

**Spark, Electric, Action of Röntgen Rays on.** [E 8.]

**Sparks, Electric, Effect of Röntgen Rays and Ultra-Violet Light on.** [E 8.]

**Sparks, Electric, and Ultra-Violet Light.** [U 1.]

**Spectrum, Cathode Ray.** [B 20.]

**Spectrum, Extension of the Visible.** [S 38.]

**Standard Lamp for Röntgen Rays.** ELIHU THOMSON. *Elec. Eng.* (N. Y.), vol. 21, p. 377. 1896. (Illustrated). **23**

**Static Machine for X-Ray Work.** *Elec. World*, vol. 29, p. 397. **24**

Description of a suitable machine, the plates being of hard rubber.

**Stcherbakof on the Source of Röntgen Rays.** [S 22.]

**Steam, Action of Röntgen Rays on a Jet of.** FRANZ RICHARZ. *Weid. Ann.*, No. 11, 1896. Abs. in *Phil. Mag.*, vol. 43, p. 75. **25**

The author found that X-rays act upon a steam-jet so as to produce a fog.

**Stefanini, A., on Röntgen Rays and Sunlight.** [S 34.]

**Stereoscopic Photos with X-Rays.** ELIHU THOMSON. [T 18.]

**Stereoscopic Radiography.** P. CZERMAK. *Photography*, vol. 8, p. 836. [See also T 18.] **26**

Details of a method of producing stereoscopic X-ray photos, with plan of apparatus and illustrations of results.

**Stine, W. M., on the Kinematics of Röntgen Rays.** [K 6.]

**Stine, W. M., on Source of Röntgen Rays.** *Jnl. of Am. Inst. of E. E.*, 13, pp. 81-84. 1896. **27**

**Stine, W. M., on Tubes for Producing X-Rays.** [T 32.]

**Stine, W. M., on Tuberculosis and X-Rays.** [T 38.]

**Stokes, Sir G., on the Röntgen Rays.** *Brit. Jnl. of Phot.*, vol. 43, pp. 585-603. **28**

Presidential address to the Victoria Institute.

**Stokes, Sir G., on Röntgen Rays.** *Nature*, vol. 54, p. 427. **29**

**Stokes, J., on Prof. Röntgen's Discovery.** [R 29.]

**Stones, Precious, and X-Rays.** [P 34.]

**Streinitz, Franz, on Electro-Chemical Action of Röntgen Rays.** [E 14.]

**Summaries of X-Ray Work are to be found in** *Photography*, vol. 8, pp. 77, 145, 161, 172, 183, 199, 216, 232, 246, 264, 271, 278, 295, 313, 329 and 344. **30**

**Summary of Work on New Rays.** A. W. ISENTHAL. *Brit. Jnl. of Phot.*, vol. 43, p. 313. **31**

**Summary of the Work of Lodge, Isenthal, Gifford, and others.** *Nature*, vol. 53, p. 613. 1896. **32**

**Summary of Röntgen Ray Work to date (Feb. 20th, 1896).** *Nature*, vol. 53, p. 377. **33**

An article of about six columns giving very full details. (See also *Popular Science* (monthly), vol. 49, pp. 103 and 124.

**Sunlight, Absence of X-Rays in.** [L 5 and S 35.]

**Sunlight and Röntgen Rays.** A. Stefanini. *N. Cim.*, 4, 3, pp. 302-306. 1896. **34**

A sensitive plate in a light-tight box, together with some sulphide of calcium, became affected when the box was exposed to sunlight.

**Sunlight, Röntgen Rays in.** C. S. Dolley and S. Egbert. *Science*, vol. 3, p. 357. **35**

The writers claim to have obtained true shadowgraphs through sheet aluminium, hard rubber, &c., by means of sunlight only.

**Surface, the Part Played by the, in Discharge Effects of Röntgen Rays.** [P 4.]

**Surgery, Laryngeal, and Röntgen Rays.** [L 3.]

**Surgery and Medicine, X-Rays in.** [M 11.]

**Surgery and X-Rays.** H. W. Cattell. *Science*, vol. 3, p. 344. **36**

Particulars of cases in which the rays have proved valuable.

**Sutherland, W., on Two New Pressure Gauges for Highest Vacua.** [G 3.]

**Swinton, A. A. C.: Effects of Strong Magnetic Fields upon Electric Discharges in Vacuo.** *Proc. Roy. Soc.* (Lond.), vol. 60, p. 179; and *Elec.*, vol. 39, p. 349. **37**

**Swinton, A. A. C.: Extension of the Visible Spectrum.** *Nature*, vol. 55, p. 33. **38**

The extension produced by fluorescent bodies.

**Swinton, A. A. C.: A Focus Tube for Use with Alternating Currents.** *Elec.*, vol. 37, p. 37. 1896. **39**

**Swinton, A. A. C., on Improvements in the Röntgen Process.** *Brit. Jour. of Phot. Almanac*, 1897, p. 641. **40**

**Swinton, A. A. C., on the Increase of Resistance within the Focus Tube.** *Elec.*, vol. 37, p. 221. **41**

A probable explanation may be found in the blackening with platinum on the interior of the tube with long use.

**Swinton, A. A. C.: Method of Reducing Time of Exposure of X-Ray Photos.** *Elec.*, vol. 36, p. 866. 1896. **42**

Suggests use of fluorescing screen as a backing to the sensitive plate.

**Swyngedauw, R., on Electric Sparks and Ultra-Violet Light.** [U 1.]

**Swyngedauw, R., on the Lowering of Static and Dynamic Discharge Potentials by X-Rays.** [L 22.]

**Szymánski on a Tube for Röntgen Rays.** [T 29.]

## T

**Temperature, Particular, of Anode Necessary.** [G 5.]

**Temperature of Vacuum Discharge.** R. W. Wood. *Weid. Ann.*, 59, pp. 238-251. 1896. **1**

**Temperatures, Low, X-Rays at.** [R 97.]

**Tension, Longitudinal, of Cathode Rays.** [L 21.]

**Tesla, Nikola, Interview with.** *Elec. World*, vol. 28, p. 127. **2**

**Tesla Spark and X-Ray Work.** F. J. Smith. *Nature*, vol. 54, p. 483. 1896. **3**

**Theories of X-Rays.** Editorial in *Elec. World*, vol. 28, p. 126. **4**

**Theory of Röntgen Rays.** A. A. Michelson. *Am. Jnl. of Science* vol. 1, series 4, p. 312; also *Elec. World*, vol. 27, p. 390. **5**

The writer considers the theory of longitudinal waves unnecessary at present to explain Röntgen ray phenomena, and thinks the projected particle theory difficult to accept because of the fact that upon that hypothesis electrified particles must be shot through the walls of the tube. The writer proposes an "ether vortex theory," the rays consisting of vortices of an intermolecular medium. These would be forced out of the cathode surface by the negative charge upon it. Rectilinear propagation and absence of reflection would follow from the properties of vortices.

**Theory of X-Rays.** *Elec. World*, vol. 27, p. 337. **6**

Rejects existing theories, although inclining to the longitudinal hypothesis, but suggests a combination of the latter with electric induction or electrolysis.

**Theory of X-Rays.** J. W. Wilkins. [W 4.]

**Thermo-Luminescence Provoked by Röntgen Rays and Becquerel Rays.** [B 27.]

**Thompson, S. P.: Letter on Prof. Fleming's Article** (*Elec.*, vol. 38, p. 302.) *Elec.*, vol. 38, p. 356. **7**

A magnet held outside a focus tube affected the position of the delimiting edge of the internal fluorescence, while at the same time the dark delimiting shadow seen on the platino-cyanide screen did not shift.

**Thompson, S. P.: Relation of Cathode, Röntgen and Becquerel Rays.** B. A. Meeting, 1896. Abstract in *Nature*, vol. 54, p. 566. 1896. **8**

Amongst other effects, Prof. Thompson noticed that if the anti-cathode be a wire, its cathode shadow enlarges when the wire is negatively charged and diminishes in size for a positive charge. (See also B 5 and 6).

**Thompson, S. P.** : Some Experiments with Röntgen Rays. *Proc. Phys. Soc.* (Lond.), vol. 14, p. 272. **9**

An account of experiments on polarisation, but giving entirely negative results. The writer also describes several forms of experimental tubes which he employed prior to the introduction of the Jackson focus tube. The writer could find no reliable trace of true specular reflection.

**Thompson, S. P.**, on Hyper-Phosphoresence. [H 4.]

**Thomson, J. J.**: Address to Section "A," B. A. Meeting, 1896. *Elec.*, vol. 37, p. 673. **10**

A comprehensive account of the X-ray work up to date.

**Thomson, J. J.** : Discharge of Electricity by Röntgen Rays. *Proc. Roy. Soc.* (Lond.), vol. 59, p. 274. **11**

**Thomson, J. J.** : Electrical Discharge by Means of Röntgen Rays. *Elec.*, vol. 36, p. 491. A letter. **12**

**Thomson, J. J. and J. McClelland** : Influence of X-Rays on the Conductivity of Dielectrics. *Elec.*, vol. 36, p. 750. **13**

The rates of leakage from a charged body in air at different pressures was investigated, and it was found to be lower at a low pressure than at a high one, and was over a large range of pressure proportional to the square root of the pressure. Effects of temperature were also studied.

**Thomson, J. J., and E. Rutherford** on the Passage of Electricity through Gases Exposed to Röntgen Rays. Paper read before the B. A. Meeting, 1896. *Phil. Mag*, vol. 42, p. 392. **14**

An account of experiments to show that air becomes a conductor of electricity under the influence of X-rays (see R 27), and that this effect was not reduced when the air was strongly heated ; passing it through water, however, stopped the phenomena. The gas lost its conductivity when passed through a plug of glass wool, but not so when passed through a diaphragm of fine wire gauze or muslin. A current of electricity when passed through Röntgenised air was also found to diminish its conductivity. When a glass tube prevented the passage of the current, but allowed the electric *field* to be maintained, the conductivity of the air was not affected. A charge was also communicated to a gas by X-rays. The authors largely deal with leakage effects under various conditions.

**Thomson, J. J.**: Quantitative Determination of Röntgen Rays. *Elec.*, vol. 36, p. 469. **15**

The rays are caused to discharge an electrified plate. Prof. THOMSON infers from his experiments that "all substances through which the Röntgen rays are passing become for the time conductors of electricity." (See also K 5.)

**Thomson, J. J.** : The Röntgen Rays. *Elec.*, vol. 37, p. 504. Abs. of Lecture delivered at Cambridge, June 10, 1896. **16**

**Thomson, J. J.** : The Röntgen Rays. [R 71.]

**Thomson, Elihu** : Effects of X-Rays on the Tissues. [T 19 and 20.]

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**Thomson, Elihu, on Fluorescence Experiments.** *Elec.*, vol. 38, p. 302. **17**

A feeble result obtained with finely-powdered glass. The author mentions experiments to test whether X-rays affect living tissues.

**Thomson, Elihu: Opalescence and Diffusion with X-Rays.** [D 10.]

**Thomson, Elihu, on a Standard Lamp for Röntgen Rays.** [S 23.]

**Thomson, Elihu: Stereoscopic Photography.** *Elec.*, vol. 36, p. 661; and *Elec. World*, vol. 27, p. 415. **18**

A practical account of how to take stereoscopic photos with Röntgen rays.

**Threlfall, R. and J. A. Pollock: Experiments with Röntgen Rays.** [R 30.]

**Tissandier, Gaston, on a Form of Crookes Tube for X-Ray Work.** [T 27.]

**Tissues, Effects of X-Rays on the.** Elihu Thomson. *Elec. World*, vol. 28, p. 666. **19**

Personal experience of the ill effects of prolonged exposure of the hand to the rays. (See also S 12).

**Tissues, Effects of X-Rays on the.** R. B. Owens. *Elec. World*, vol. 28, p. 759. **20**

Details of two cases where patients have developed bad wounds on the parts operated upon.

**Transparency of the Eye to X-Rays.** [E 22.]

**Transparency of Gases to Röntgen Rays.** [B 15.]

**Transparency of Liquids to Röntgen Rays.** M.M. Bleunard and Labesse. *C. R.*, 122, pp. 527-528. 1896. **21**

The writers placed the liquids to be examined in trays of tallow. (See also O 6).

**Transparency to Röntgen Rays.** E. vanAubel. *Jour. de Phys.*, 5, pp. 511-514. 1896. **22**

Experiments on the relative transparency of bodies to the rays. The writer found that the presence of chlorine, bromine, iodine, or fluorine in a molecule renders the substance more opaque. Vapours of salts were found to be very transparent.

**Triangulation by Means of Cathode Photography.** J. Trowbridge. *Am. Jnl. of Science*, March, 1896; and *Phil. Mag.*, vol. 41, p. 463. **23**

The author describes a method of estimating the relative positions of objects by means of X-rays and suggests stereoscopic effects. (See also T 18).

**Troost, L., on X-Rays from Artificial Blende.** [A 18.]

**Trouton, F. T.: Duration of X-Radiation at each Spark.** B. A. Meeting, 1896. Abs. in *Nature*, vol. 54, p. 566. **24**

He found that the duration varies from $\frac{1}{300}$th to $\frac{1}{10000}$th second.

**Trouton, F. T.: Letter on Photographic C. P. of X-Ray Tubes.** *Elec.*, vol. 38, p. 699. [See R 26.] **25**

**Trowbridge, J., on Triangulation by means of Cathode Photography.** [T 23.]

**Trowbridge, J., on the Energy of the X-Rays.** *Elec. Rev.* (N.Y.) vol. 30, p. 139. **26**

The writer employed a battery of 10,000 cells to charge a set of Leyden jars giving a discharge at 500,000 volts. One of the conclusions he arrived at was that when X-rays were given off the discharge was always oscillatory.

**Tube, a Form of Crookes, for X-Ray Work.** GASTON TISSANDIER. *La Nat.*, No. 1,200, p. 401. **27**

This is not a focus tube, but the results of photos taken with it show great sharpness.

**Tube for Röntgen Rays.** J. W. GIFFORD. *Nature*, vol. 53, p. 460. 1896. **28**

**Tube for Röntgen Rays.** SZYMÁNSKI. *Zeit. f. Instrumk.*, 16, pp. 153-155. 1896. **29**

A simple tube of glass some 15cm. long and 3cm. wide. It was capped at each end with aluminium and provided with a side tube for exhausting. The caps acted as the electrodes, one, the anode, being convex outwardly and the cathode flat. The caps had a sufficient flange and were cemented on with shellac, with an outer coating of marine glue. Photos were taken with this tube (using American ferrotype plates) in two seconds.

**Tubes, Crookes, for Use with Alternating Currents.** [C 20.]

**Tubes, Crookes, a New Form of, for Rapid Exposures.** [C 21.]

**Tubes, Crookes.** C. C. HUTCHINS and F. C. ROBINSON. [C 22.]

**Tubes, Crookes.** L. SEGALIN. [C 24.]

**Tubes, Crookes.** E. VILLARI. [C 27.]

**Tubes for Röntgen Rays, Regulation of.** B. WALTER. *Elek. Zeit.*, Jan. 7, 1897. **30**

The regulation is effected by heating a portion of the tube containing caustic alkali.

**Tubes for Röntgen Rays.** H. BOAS. *Zeit. f. Instrumk.*, 16, pp. 117-119. 1896. **31**

**Tubes, Röntgen.** H. ARMAGNAT. [R 119.]

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**Tubes Productive of Röntgen Rays.** A. Righi. *Rend. Acc. Linc.*, 5, 2, p. 47. 1896. [See R 25]. **34**

Chaband and Hurmuzescu hold the opinion that in considering the necessary rarefaction to produce X-rays it is also essential to take into account the form of the tube. Prof. Righi does not agree with this.

**Tubes for the Production of X-Rays.** *Nature*, vol. 55, p. 297. **35**

An illustrated description of many forms of tubes.

**Tubes for Producing X-Rays.** [R 25 and T 9.]

**Tuberculosis Cured by X-Rays.** Note in *Nature*, vol. 54, p. 255. [See also *La Nat.*, No. 1,184, p. 157 ; also B 1 and 3.] **36**

**Tuberculosis Destroyed by X-Rays.** M.M. Lortet and Genoud. *C. R.*, 122, pp. 1.511-1,512. 1896. [Also B 1 and 3.] **37**

Eight guinea-pigs were inoculated with the bacillus and three were subjected to Röntgen rays for about three months, these three remained free from the effects of the poison, while the rest developed abscesses and other symptoms of disease.

**Tuberculosis and X-Rays.** W. M. Stine. *Elec. World*, vol. 29, p. 10. **38**

Results of a series of investigations carried out with specially good results.

**Turner, Dawson: Are Ordinary Photographic Plates as Sensitive to X-Rays as Extra-rapid ones?** *Elec.*, vol. 38, p. 978. **39**

## U

**Ultra-Violet Light and Electric Sparks.** R. Swyngedauw. *C. R.*, 122, pp. 1,052-1,054. 1896. **1**

**Uranium, Metallic, Radiation from.** [B 13.]

## V

**Vacuo, Photography in.** [P 26.]

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**Vandevyver, L. N., on Law of Photographic Action of X-Rays.** [L 4.]

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**Varley, F. H., on Radiography.** [R 4.]

**Velocity of Propagation of Electrostatic Force.** [K 2.]

**Velocity of Röntgen Rays.** A. Sella and Q. Majorana. *Rend. Acc. Linc*, 5, 1, pp. 168-169. 1896. **1**

An ingenious method of experimenting, but the article contains no results.

**Veterinary Applications of X-Rays.** [R 116.]

**Vicentini, G., and G. Pacher on Röntgen Rays.** *Mem. R. Istit. Ven. di Scienze*, vol. 25., No. 7. 1896. **2**

**Villari, E., on Bending of X-Rays.** [B 14.]

**Villari, E., on Crookes Tubes.** [C 27.]

**Villari, E., on Discharge by Röntgen Rays.** [D 17.]

**Villari, E., on Discharge by Röntgen Rays, or by Electric Sparks.** [D 18.]

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**Villari, E., on Discharge by Röntgen Rays, in Solid, Liquid, or Gaseous Media.** [R 83.]

**Villari, E., on Distribution ot Electricity on the Surface of Crookes Tubes.** *N. Cim.*, 1, c., p. 359; also *Elec. Rev.* (Lond.), vol. 39, p. 552; and *Nature*, vol. 54, p. 639. **3**

**Villari, E., on Gases Exposed to Röntgen Rays.** [G 2.]

**Villari, E., on Röntgen Rays.** *N. Cim.*, 4, 3, p. 228. 1896. **4**

Anodic rays are to be taken into account as well as the cathodic rays. The cathode rays travel in straight lines and manifest their negative charges where they strike the walls of the tube. The anode rays are diffused within the interior of the anode, and manifest their positive charge over the whole of the tube.

**Villari, E., on Röntgen Rays.** [R 72, 73, 74, 75, and 76.]

**Villedevil, Ch. de: Photographing the Invisible.** [P 15.]

**Visibility of Röntgen Rays.** G. Brandes. *Berl. Ber.*, 24, pp. 547-550. 1896. **5**

An interesting case of a girl who had had the crystalline lense of one of her eyes removed, and who could see light when Röntgen rays were turned on.

**Vitrified Materials, Fluorescence of, under Röntgen Rays.** [F 8.]

## W

**Wade, Sir W., on the "New Radiation."** *Brit. Med. Jour.*, vol. 1., p. 433. 1896. [Also T 36, 37 and 38.] **1**

A suggestion that Röntgen rays may prove destructive to bacteria, especially of tuberculosis.

**Wall, E. J., on Cathode Photography.** [C 2.]

Walsh, Dr., on Skin Pictures by Röntgen Rays. [S 13.]

Walter, B., on Regulation of Röntgen Ray Tubes. [T 30.]

Watson, G. W., on Radiography. [R 8.]

Wave Length of X-Rays. H. A. ROWLAND. *Elec. World*, vol. 27, p. 462. 2

The author gives an approximate length for the waves of 0·0000007 cm., or one-seventh that of yellow light.

Wave Length of X-Rays. [F 15.]

Waves, Longitudinal, Generation of in Ether. Lord KELVIN. *Proc. Roy. Soc.* (Lond.), vol. 59, p. 270. 1896. 3

A suggested method of obtaining longitudinal waves in ether without employing an exhausted tube.

Waves, Longitudinal. [B 23.]

Webster, G. W., Radiography in Practice. [R 5.]

Weidemann, E., and G. C. Schmidt on Discharge Phenomena in Rarefied Metallic Vapours. [D 14.]

Wilkins, J. W.: A Theory of X-Rays. *Elec.*, vol. 38, p. 516. 4

Assuming them to be vibrations of special matter.

Willyoung and Sayen on Röntgen Ray Work. [R 118.]

Willyoung and Sayen on Apparatus for Producing Röntgen Rays. [A 15.]

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Wimshurst Machine and X-Rays. W. WATSON. [R 8.]

Wimshurst Machine and X-Rays. [B 22, P 33, and X 17.]

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Wood, R. W., on Temperature of Vacuum Discharge. [T 1.]

Wooden Cylinder for X-Ray Lamp. [B 18.]

Woodward, J.: New Form of X-Ray Lamp. *Elec.*, vol. 36, p. 735; also *Elec. World*, vol. 27, p. 219. 5

A conical aluminium vessel with glass base.

Wright, A. W., on Cathode Ray Experiments. [C 7.]

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## X

**X-Rays and Alternating Currents.** [A 10.]

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Use of a camera for obtaining reduced photographs of the images on fluorescing screen. The action of X-rays upon living tissues.

**X-Rays, Experiments with.** W. C. PECKHAM. *Elec. World*, vol. 27, p. 633 **8**

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**X-Rays in Geissler and Crookes Tubes.** [P 8.]

**X-Rays, The.** CH. GUILLAUME. *La Nat.*, No. 1,183, p. 129. **9**
A general account of the discovery.

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**X-Rays, Interview on, with Mr. Jackson.** *Elec. Rev.* (Lond.), vol. 38, p. 470. **10**

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A general summary of contemporary work, and mentioning Lord BLYTHESWOOD's results with brush discharge, EDISON's results and an account of an X-ray tube made from 16-c.p. lamp bulb. Attention is called to the fact that X-rays retard the rotation of a radiometer.

**X-Rays and the New Photography.** [N 5.]

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**X-Rays with a Wimshurst Machine.** O. Lodge. *Nature*, vol. 55, p. 100. **17**

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## Z

**Zeeman, P.: The Influence of Magnetism on the Nature of the Light Emitted by a Substance.** *Phil. Mag.*, vol. 43, p. 226. **1**

A Paper read before the Royal Academy of Science, Amsterdam, Oct., 1896. The author caused a beam of light to be passed through a heated tube containing sodium vapour, and which was placed between the pointed poles of a powerful magnet. The spectrum bands under these conditions peculiar to the substance emitting light were broadened by the action of the magnet.

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